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HOME POWER

THE HANDS-ON JOURNAL OF HOME-MADE POWER

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Home Power

THE HANDS-ON JOURNAL OF HOME-MADE POWER

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Think About It

"Nobody has to die for solar energy."

Paul Wilkins commenting on the latest oil crisis at SEER '90.

Cover

The solar powered Sun Seeker aircraft in flight. This aircraft crossed the USA from CA to NC in 22 days on just Sunshine! Article on Page 6.

Photo courtesy of Eric Raymond.

Thoughts of a day in the Sun!

Patrick McGinn

Blue, platinum curtains of late evening light drape along the redwood tree capped hills of this Northern Californial Valley. At a distance, a huge white light "W" stands out finely amongst the trees, standing for Willits, solar capitol of the World.

A gathering is taking place here, more than friends meeting or times changing, this gathering is a stated change in history, a tight turn in mankind's curious sojourn. It can be felt in the charged, excited, inspiring atmosphere of SEER 1990, Solar Energy Exposition and Rally. This August weekend, when a new and unique tribe of gypsies are together to give homage and justice to new uses of an ancient form of heat and light from the sun.

All day, strange new things have been crossing my path: squat, gull winged vehicles, parkayed with mosaics of blue, sand derived chips, wired to motors which drive thin bicycle tires, some built by students from far off places. Around me, exhibitors proffer gallant technologies for capturing heat, creating cold, dispensing communications and redirecting labors.

The chatter of solar wisdom, experience, and inquiry emanate from every mind and lifestyle pattern. The division between the novitiate and the expert blend and intermingle upon these sun drenched fairground lands, embodying one of the most grand "learning missions" mankind has ever confronted. Young in mind and tribal in shared experience, these solar gypsies are magnetically drawn here, aligned with a new slave, harnessed to an unquestionably workable future, based on life "93 million miles " to the center of our solar system. A new team of horses, friendly and benign, able to be hauled and installed by any of you,is here. And that is what they are saying, "Any of you can do it." The learning mission destroys the myth; the technology simplifies and actuates the "new slave", and like good gypsies, extolling life founded upon joy, freedom and friendship, revel in their mission, strutting the beauty of solar cells on trackers, finely balanced wind machines, and storage banks pumping energy into Maytags, humming happily with full loads of levis, sloshing about in solar heated water.

And the slave does not complain. The gypsies dance and twirl like dervishes of history, knowing the more the slave is asked to do, the more it loves it. In dreamy, wild eyed moments, it's unquestionably certain the gypsies are now ready to share their slave with the people of the planet, and in doing so, will make a major step toward making this planet more free, happy and healthy.

August Night, Willits, California

Patrick McGinn, Rt. 3, Box 33, Lamy, New Mexico 87540

ALTERNATIVE ENERGY ENGINEERING
AD
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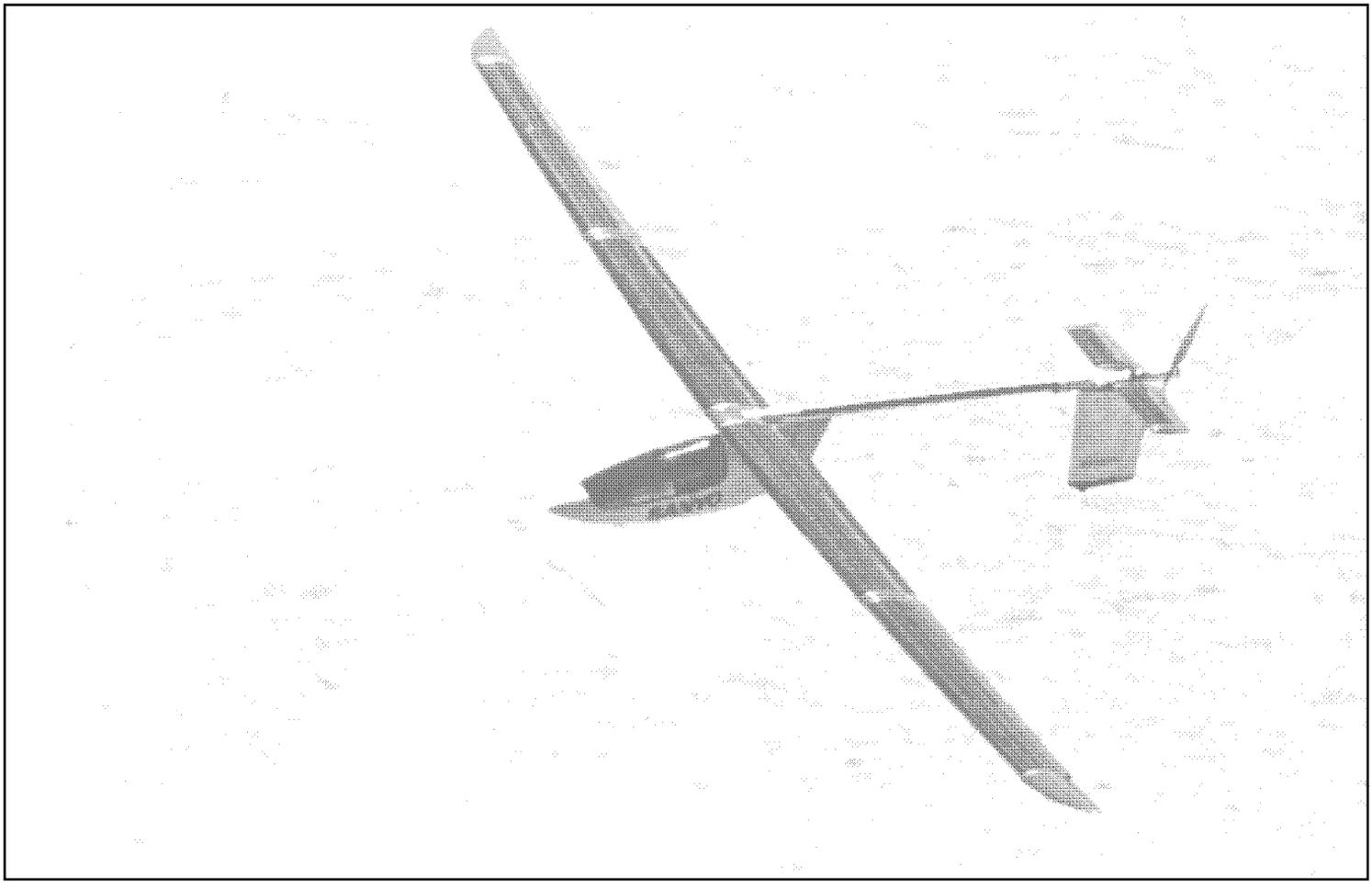


SOLAR POWERED FLIGHT

Richard Piellisch

This summer's flight of a photovoltaic-powered airplane from California to Kitty Hawk, N.C., was a double milestone, making history in both aviation and photovoltaics. The cross-country jaunt by hang-glider specialist Eric Raymond, of Lake Elsinore, California, was by far and away the longest fuel-less flight ever, while the use of PV power to drive his 198-pound plane's three-HP motor marked a major, attention-grabbing breakthrough for renewable energy technology. This flight, which began in Desert Center, California, July 16, 1990 and ended in the coastal town of Spot, North Carolina on September 3, 1990, set a new world record for a solar-powered aircraft. Eric Raymond logged 2,523 miles during 125 hours and 1 minute in the air.

The nonstop, 'round-the-world flight of the Voyager in December 1986 captured the world's imagination. Pilots Dick Rutan and Jeana Yeager were heroes. Their plane hangs in the Smithsonian, just one room over from those of Lindbergh and the Wright Brothers. Yet the Voyager took off and landed from the same point. As a curiosity the flight was awesome, but its utility has been limited to Air Force interest in technology to help keep drone spy planes aloft for long periods. Eric Raymond's Sun Seeker, on the other hand, made it across the United States using no fuel save the light of the sun. Sun Seeker may someday pave the way for an era of safe, stately, quiet, environmentally benign flight. Airships ... PV-powered blimps ... think about it.

The Sun Seeker

Raymond's plane, essentially a glider with 88.5 square feet of amorphous PV cells from Sanyo powering its wheelchair-type Inland motor, flew from Desert Center, California, to Kitty Hawk, N.C. Raymond stopped each evening, and Sun Seeker got an additional charge each morning from an extra array of Sanyo cells laid out on the ground. There were various breaks in the journey as Raymond coped with mechanical difficulties and fatigue. Future cross-country flights will be competitive events, with tougher rules. But Raymond and the Sun Seeker will still have been first.

His achievement, and that of the Sun Seeker is similar in many

ways to the evolutionary development of PV power itself. Like PV users, Raymond had to be practical. Expediency has been his watchword. It was a matter of practicality to use extra PV cells to reduce charging time (Raymond might otherwise have been able to fly only every other day; as it was, adverse weather and exhaustion made stops of more than one day necessary). The Sun Seeker crew made do in much the same way that home PV users get by with fewer lights, reading by daylight when they can, dispensing with electric appliances they don't really need, keeping the limitations of the technology in mind.

Perserverence Furthers

Raymond persevered through numerous technological and mechanical setbacks. His plane was originally able to take flight with just a one-HP motor, but the addition of the PV cells on its upper surfaces tripled that energy requirement. The amorphous ribbon cells posed no weight problem, but, unexpectedly, they did disrupt the critical smoothness of the plane's laminar-flow wing design, meaning that a stronger push from the propeller was necessary to generate adequate lift. So Raymond and designer Klans Savier, of Light Speed Engineering (Fountain Valley, CA.) tore into the plane and installed a bigger motor.

Various problems, including the selection of an appropriate takeoff site, forced the postponement of a planned July 1 departure. Raymond and his wife Aida, an engineer who helped build Sun Seeker, finally settled on an old Army air station in the Mojave just north of Desert Center, CA., between Indio and the Arizona border at Blythe. Palm Springs was the nearest town of note. Cloudy weather delayed the planned July 10 departure of Sun Seeker from Desert Center and Raymond didn't get started on his first cross-country attempt until July 16. That day he flew 245 miles, to the Sky Ranch airport at Carefree, Arizona, north of Phoenix, and the next day Sun Seeker made it to Lordsburg, New Mexico. But his takeoff attempt the day after that, at 4,300 feet the highest-ever for Sun Seeker, ended in a 15-mph crash and an ignominious drive back to Lake Elsinore for repairs. Several weeks and a better propeller later, with no chase plane now as Sanyo cut back on its corporate support, Raymond tried again.

Even before the historic flight was underway Raymond had flown from Desert Center to Phoenix and in doing so shattered the overall distance record for gliders, or fuel-less airplanes. The larger failure of the Lordsburg crash overshadowed that achievement, just as low energy prices during the 1980s have made Western consumers smirk at the mention of solar power. Yet PV has quietly become critical to satellites, navigation aids and other hardware that's essential to their consumer lifestyle.

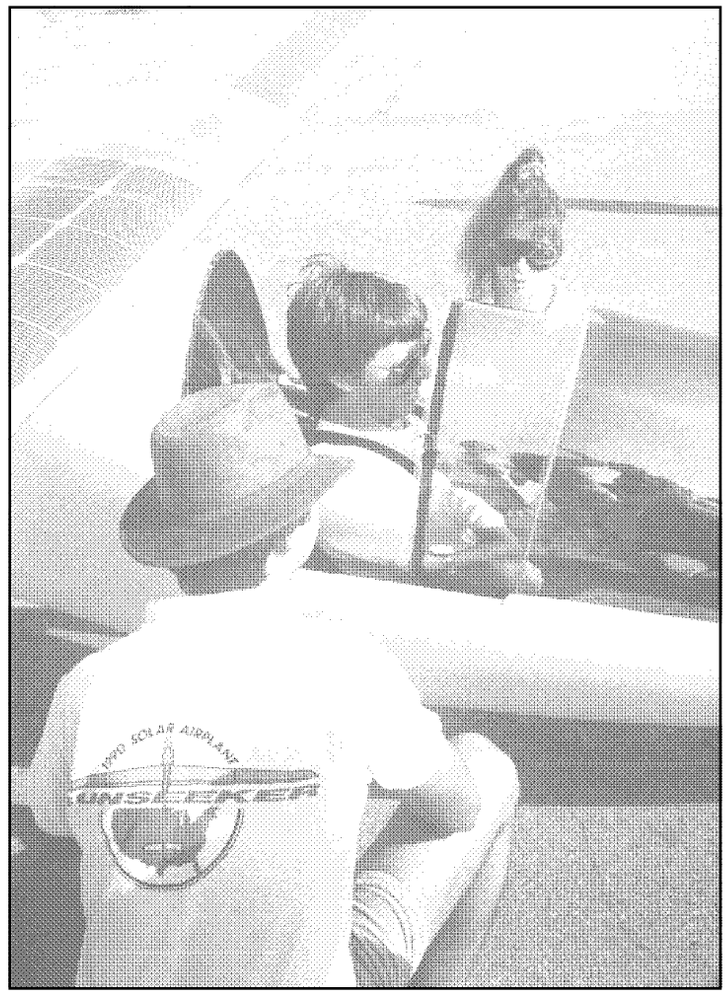
Like other technologies first developed in the United States, photovoltaics shows signs of future dominance by the Japanese. Of the 60 or so spectators watching Raymond perform flight tests at Desert Center one Saturday morning in July, approximately 40 were from Japan.

Success!

The Sun Seekers journey encompassed 22 days when the final flight ended 10 miles short of Kitty Hawk on September 3, 1990. After 23 flights, the only veteran crew of PV powered planes can stand proud of their accomplishments.

My impressions of the Sun Seeker

I'm not a PV techie but rather a business journalist, formerly specializing in aerospace materials. I've gotten interested in photovoltaics as a matter of idealism, or faith if you will. I believe that PV technology is one of man's finest achievements, that it represents his highest potential, and that it offers one of the best hopes for the planet. My first impression on seeing Sun Seeker was Wow, It's Beautiful -- I was struck by the geometrical grace of the rectangular black cells on the little white plane's big long wings. It seemed to me to be -- The Future. When it flew, and the only noise was the swift swish of the two-bladed propeller against the air, I flew too. So please forgive me if this report seems biased, or over-enthusiastic. I am an advocate, a cheerleader, no doubt about it.



Seated in the Sun Seeker is Eric Raymond with his wife Adia looking in; with his back to the camera (note the nifty shirt!) is Kenji Barba, who with Eric, Aida, and Klaus Savier built the PV powered aircraft.
Photo by Judith Carroll

Access

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Designers, Buliders & Pilots of the Sun Seeker:
Eric & Aida Raymond, 33274 Baldwin Blvd., Lake Elsinore, CA 92330

Maker of the thin-film PVs used in Sun Seeker:
Sanyo, Corporate Communications Dept., 666 Fifth Avenue, New York, NY 10103 • 212-315-3232

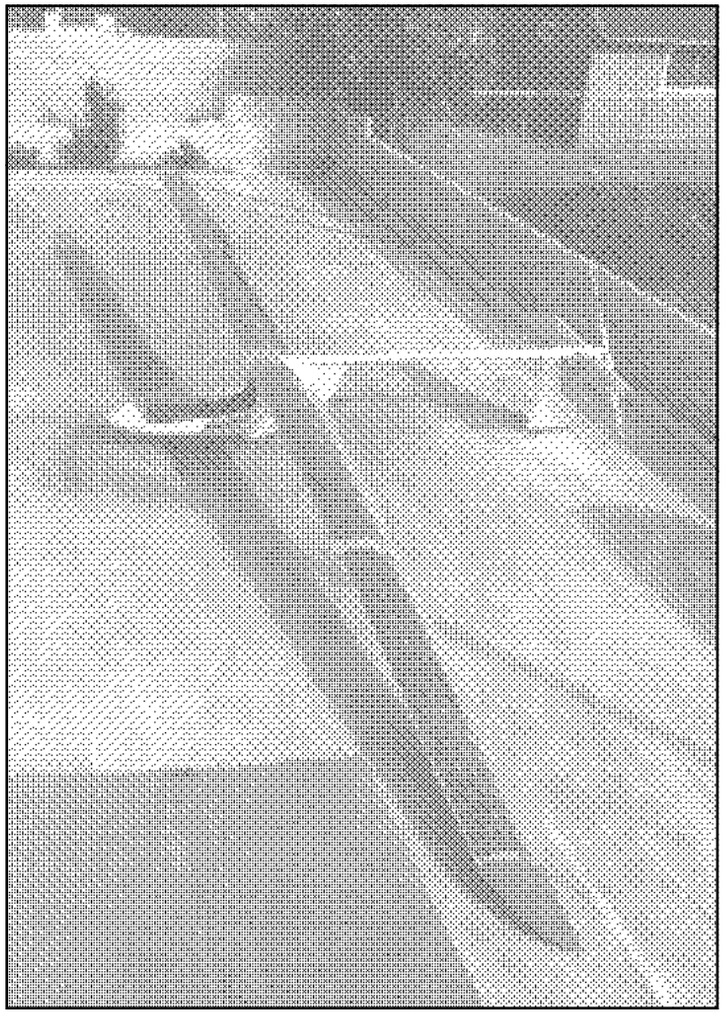
Sun Seeker- Solar Powered Ultralight Aircraft

Christopher Dymond

Getting a human airborne is hard, getting a human airborne using only solar energy is vastly more difficult. "If man was meant to fly God would have given him wings"… so the saying goes. Well, in the case of the Sun Seeker maybe brains are what was needed, lots of tanned brains that is.

Above: Eric and Anita Raymond stand beside their creation, Sun Seeker.

Right: Sun Seeker relaxes in the back yard. The logistics of hauling this fragile bird to and fro must be staggering.



The Sun Seeker was the first aircraft to traverse the continental U.S. on solar energy alone. The PV panels and battery reserves were used for lift off. The majority of the lift was found in rising warm air or thermals, used just as sail plane would. Thermals are just another one of natures way of packaging solar energy.

Full power was needed to lift off and was available for 10 to 15 minutes from both the batteries and PV array combined. While in flight any energy not imminently needed was stored in the batteries. Average duration time of motor use was under five minutes. The energy developed by the array took about 2.5 hours to charge the batteries. The batteries were then used either for take-off the next day or flying under power to the next thermal.

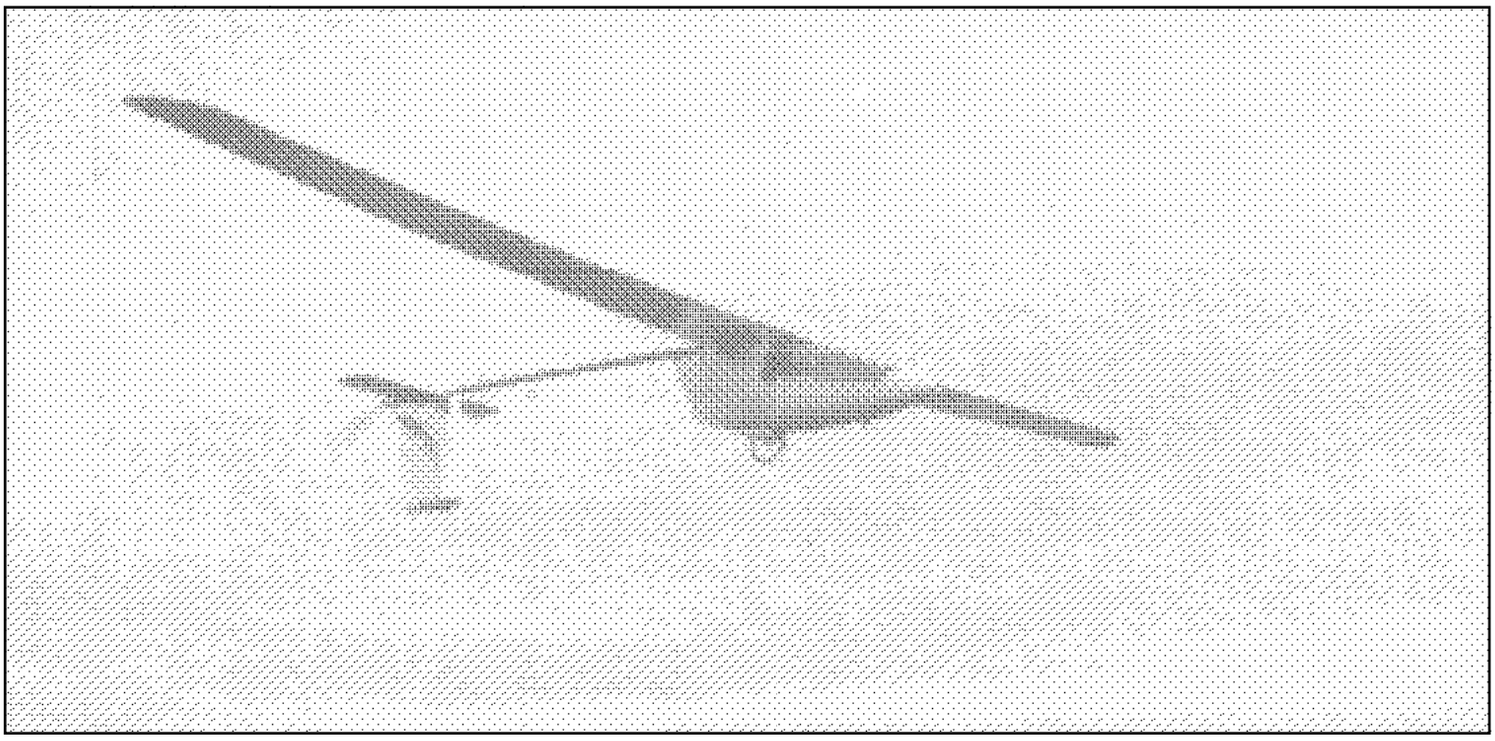
To get a feel for the vast difference between flying by solar energy and flying by petroleum-fueled engines, consider the following comparisons. Keep in mind that the function of this comparison is not to draw direct analogies but rather to tickle your brain.

The most striking specification of the Sun Seeker is its weight compared to the size of its wings. At a little under 200 lbs. it's another example of the incredible strength to weight ratio of advanced composites. Stall speed is 22 mph. The craft was constructed largely of graphite fiber and epoxy. Components as large as 23 feet in length required high temperature (350-degree) curing. A special monster sized oven was built for this purpose. Taking four years to complete, this aircraft was from conception designed to be pound-for-pound the most efficient aircraft possible.

See "what it takes to fly with the sun" sidebar on page 10 for more on the Sun Seeker specs.

The PV array used on Sun Seeker ran at 160 VDC open circuit, 120 VDC under load, and produced about 2.5 Amperes of current. The 300 Watts of PV produced power was fed into a FET power controller and finally to the 110 Vac synchronous motor.

One of the biggest design concerns when building a solar powered vehicle of any kind is to be able to generate enough power from the exposed surface area to run the motor. In the case of solar powered flight, the amount of available area was not so much a problem as was the cells' weight and applying them to a curved surface without generating too much drag. A primary reason for the development of the Sun Seeker was to test and demonstrate the new, ultralight photovoltaic cells developed by the Sanyo Corp.



Above: the Sun Seeker in flight. Sun Seeker is a modified sailplane, and because it is an active system with PVs, batteries and a motor, it can take off under its own power. No tow aircraft needed. After taking off, Eric would shut the electric motor off and cruise on the thermals while the PVs recharged the batteries.

Right: This table and chart draw comparisons between the Sun Seeker, an ultralight powered by a gasoline engine, and a conventional single placed aircraft powered by a gasoline engine. Note the performance characteristics compaired to the amount of power used. Sun Seeker is a much more efficient aircraft than gasoline burners.

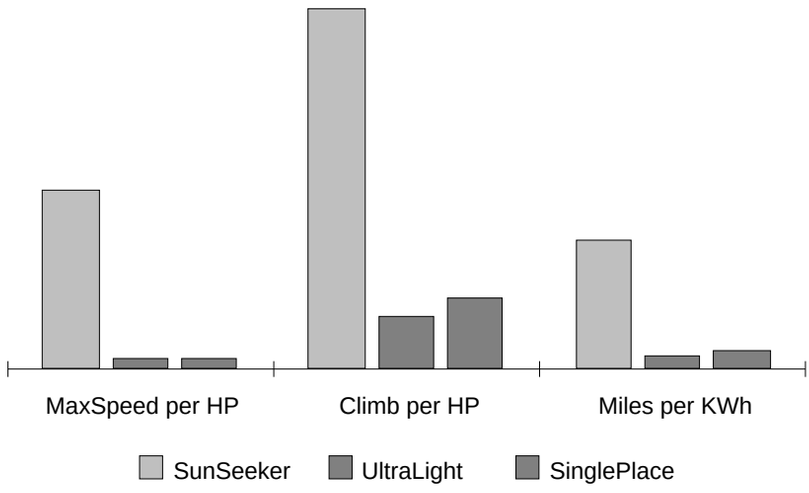
These new cells were contoured to the wings of the aircraft, and used instead of heavier, rigid conventional PV cells.

The new PVs are based upon thin film cells bonded to a thin substrate called Amorton. This thermoplastic polymer has the necessary properties of being both heat resistant, flexible and transparent. PV cells are usually made on a glass substrate because, among other reasons, glass yields no contaminating off-gases during the extremely precise, high-temperature chemical process used to make the actual photovoltaic material. According to Yukinori Kuwano general manager of the Japanese company's functional materials research center in Osaka, Japan, Sanyo got the technology from another Japanese firm for a polymeric substance which, like glass, poses no off-gassing problem during cell production. The layers of amorphous silicon are bonded to Amorton producing very flexible, ultra-light PV cells about 600 times thinner than conventional cells. The cells are a mere 21 microns thick, weigh about 2 grams and are capable of being bent to a

Comparison of the PV powered SunSeeker Aircraft with an Engine Powered Ultralight & Single Place Aircraft

Just The Facts	SUN SEEKER	ULTRALIGHT	SINGLE PLACE
WEIGHT (lbs)	199.0	170.0	440.0
WING SPAN (ft)	57.4	34.0	18.0
MAX SPEED (mph)	99.0	50.0	170.0
CRUISE SPEED (mph)	40.0	35.0	150.0
CLIMB (fpm)	200.0	250.0	1000.0
RANGE (miles)	245.0	80.0	300.0
POWER (hp)	2.6	22.0	65.0

Derived Data	SUN SEEKER	ULTRALIGHT	SINGLE PLACE
MAX SPEED per HP	38	2	3
CLIMB per HP	77	11	15
MILES per KWH	28	3	4



radius of only 5 mm. The power to weight ratio of these cells is 10 times that of regular cells.

The draw back of these PV cells is their fairly low efficiency (approximately 4-5%). According to Sanyo this degrades by about 15% in the first year. Their efficiency continues to drop until it reaches about 70% of the initial ability at the end of 3 years. The cells then stay at this level for the remainder if their life which is estimated at 5 to 6 years total. Cost the these cells are high now but may drop as mass production gets underway.

Imagine having your tent or a canopy composed entirely of electricity generating material. Or perhaps boarding an airship who's exterior is entirely composed of flexible PV cells, the electric motors quietly propelling you along. Sure beats the heck out of train travel.

What it takes to fly with the Sun

Sun Seeker Specifications

Motor	2000 W - 110 Vac Synchronous
PV Cells	600 110 mm x 115 mm cells 100 55 mm x 115 mm cells
Power available	2.5 amps @ 120 volts
Batteries	96 D-cell Sanyo NiCads 4.2 Amp-hrs. @ 1.2 VDC Charge time 2.5 hrs.
Mass	91 kg. (198 lbs.)
Cargo	67 kg. (147 lbs.)
Length	7 m. (23 ft.)
Height	1.3 m. (4.3 ft.)
Wing Span	17.5 m. (57.4 ft.)
Fuselage	Carbon fiber sandwich honeycomband fiberglass with epoxy resin
Design limits	6 g acceleration
Propeller	Hybrid cloth, fixed pitch weight 1.4 kg. (3.1 lbs.) length 2.4 m. (7.9 ft.)
Rate of Climb	60.8 m./min. (200 ft./ min.)
Ceiling	14,000 m. (46,000 ft.)

Energy Fairs!

Dreams can become real. The Green Dream certainly did so at all the Energy Fairs held this summer. Thousands attended fairs in Summertown TN, Truxton NY, Willits CA and Amhurst WI. We dreamed a sane, safe, renewable future for all on this planet to share.

People, not Panels

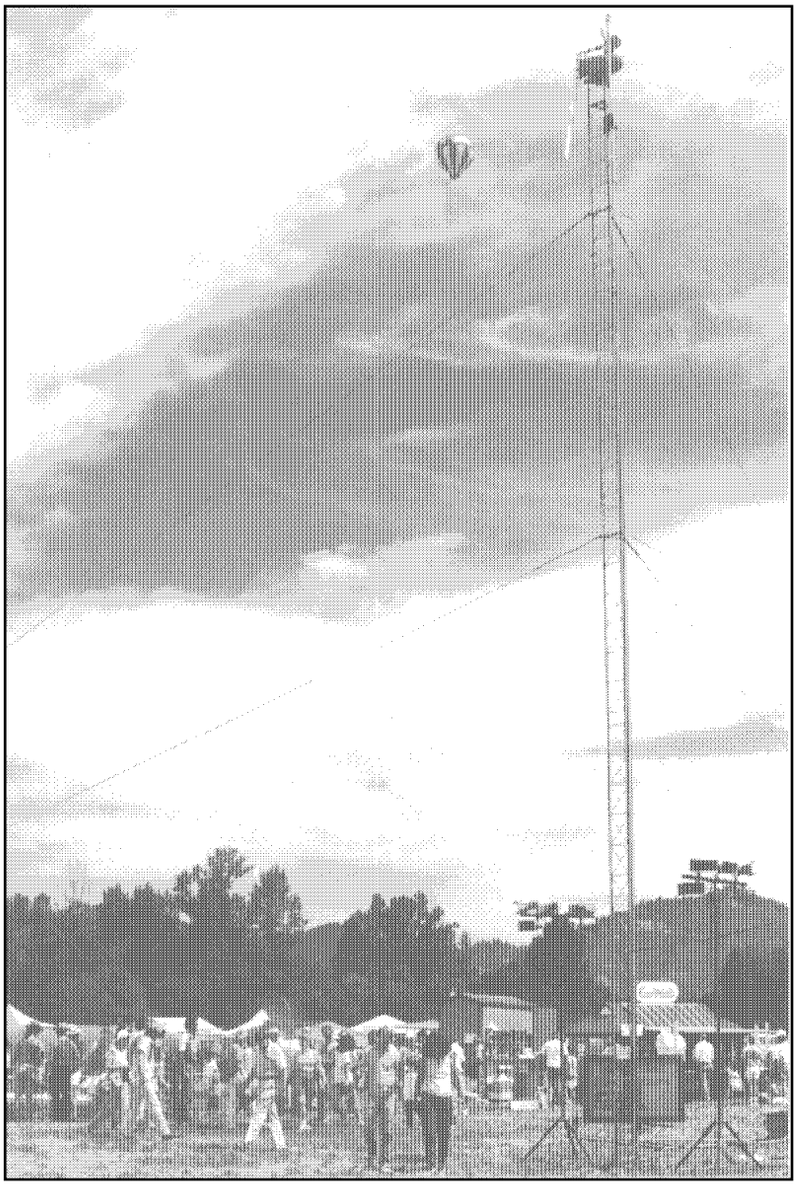
Our practice of renewable energy leads us to focus on things. Things like PV panels, hydro generators, wind machines, batteries and inverters. It's easy to get fixated on the hardware, the technology and its application. It's easy to forget what this is really about- the people who make and use the hardware. These are the folks whose work and dreams have made the use of renewable energy a reality. And this summer's fairs brought us together to share information, courage and laughter. It was a chance to meet old friends for the first time. It was a festival of life shared & celebrated by everyone.

So that's what this report is about- people. In documenting these fairs, I first attempted to take the point of view of a reporter- a disinterested and impartial observer recording the proceedings. I failed miserably. Here is the point of view of a participant. Attempts to be disinterested resulted in lame information ending in a "You had to be there…" attitude. So please understand that these reports, while entirely factual, are first person, from my experiences at the Fairs. Since I can only be in one place at a time, these reports are bound to contain omissions. My apologies in advance to people and events not mentioned. Those of you that were there will understand, those of you who missed attending the Fairs will hopefully come to know the flavor and fervor of the events. So here goes-- Gonzo photo journalism.

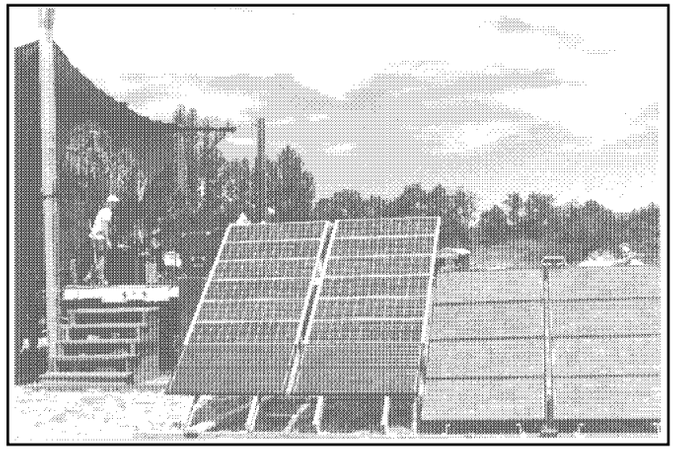
Richard Perez

Above: The Home Power Booth at SEER '90. On display was a working PV system (including six panels, inverter and nicad batteries), a PV powered pumping demonstration and a SOMA windmachine. The electrical system at the booth powered lighting, a microwave, a Mac SE with printer, radios, a strobe, sundry power tools, and a blender. We had enough leftover energy to recharge video camera packs for the visiting news crews! The booth hummed with RE activity long into the night. We met over a thousand Home Power readers here for the first time face to face. The HP Crew had too, much too, good a time. Our only problem was seeing all there was to see and manning the booth at the same time.

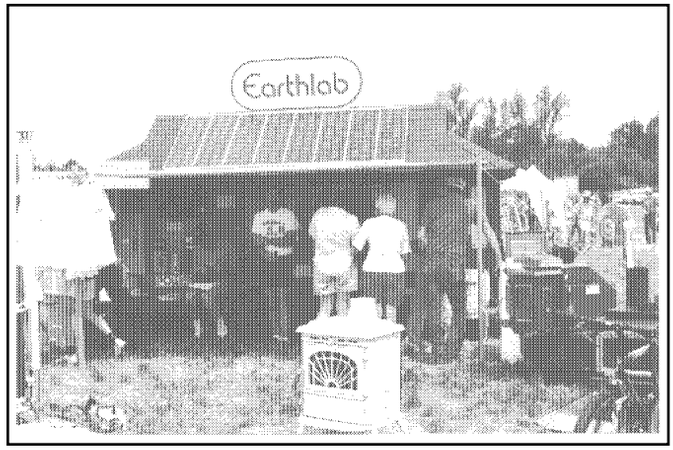
Photo by Richard Perez



Above: Wind power as well as PVs were displayed to the

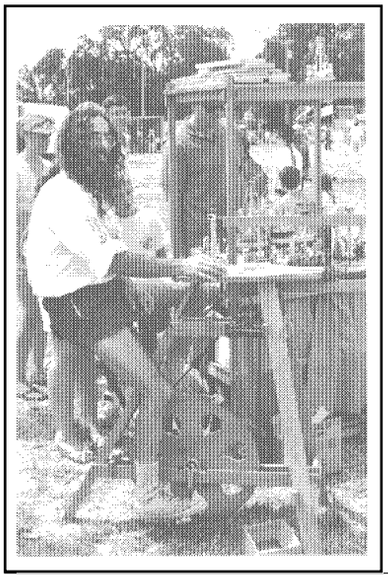


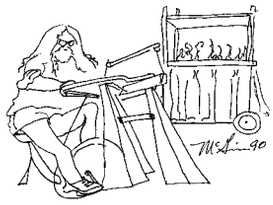
Above: this monster PV array provided power for the stage. Lurking behind the stage was a flat-bed truck full of batteries and inverters that powered the gear at night.



Above: A local Willits business & SEER '90 organizer, Earthlab was busy with everything from PVs to woodstoves.

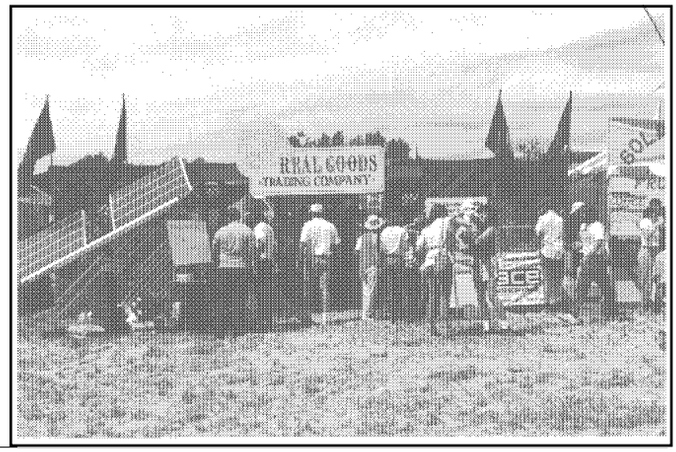
Below: things are hopping at the Real Goods booth where thousands tried out everything from efficient lights to low flow shower heads.



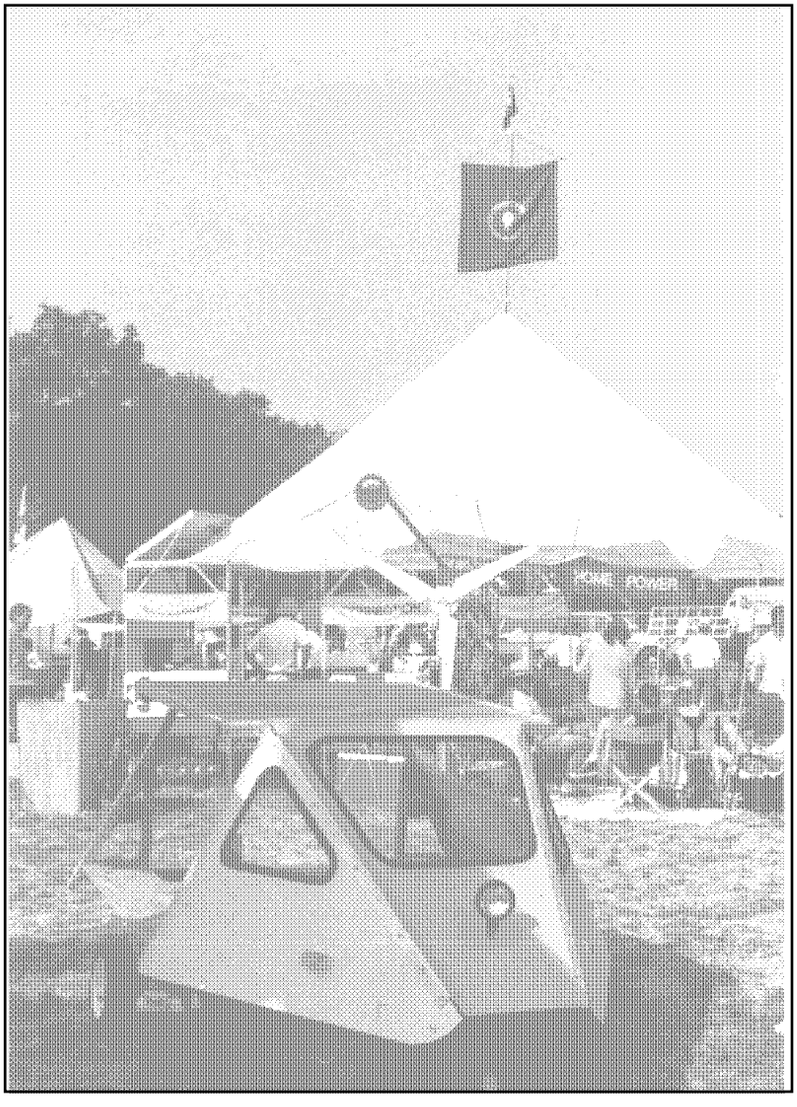


Left & Above: not all was high-tech energy. This toymaker used good ole' muscle power to make his creations. Perhaps this was the best lesson: Use what is on hand and appropriate!

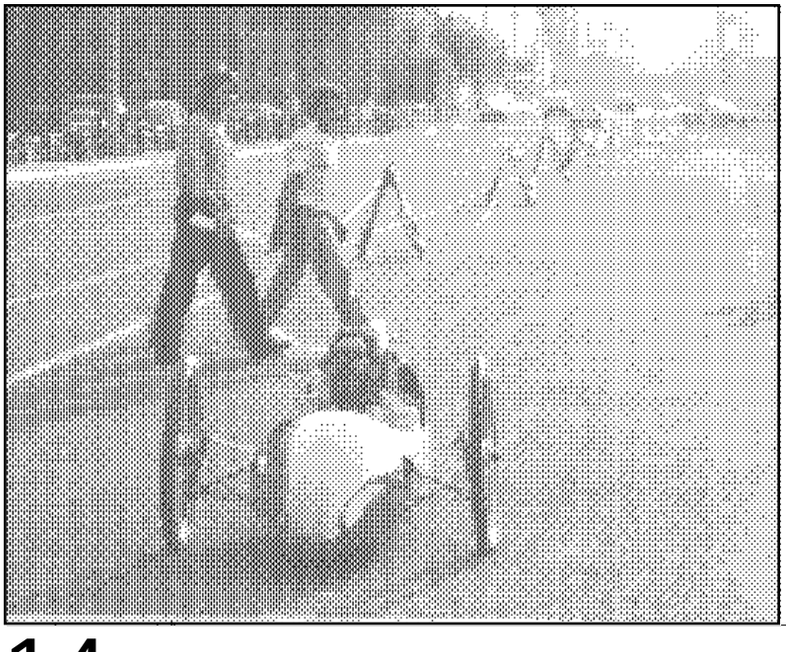
Photos by Richard Perez.
Line Art by Patrick McGinn.

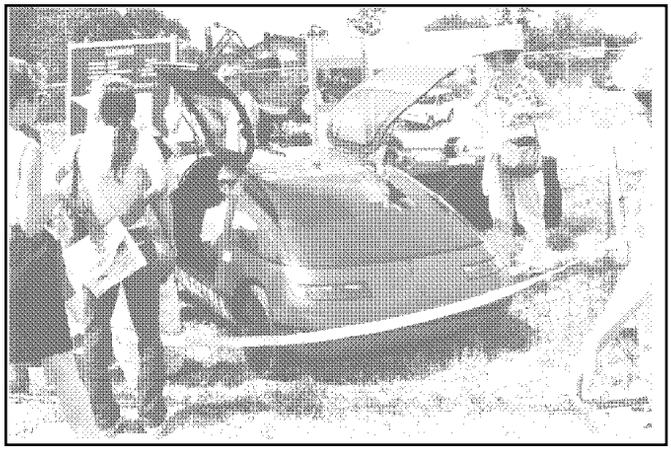


SOLAR CARS!

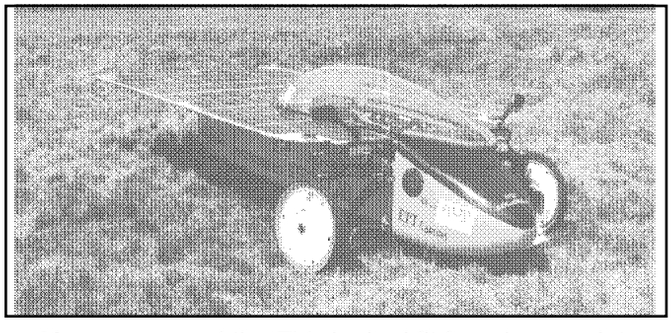


Above: Phil Jergenson at Suntools created the Vanda solar car shown in front of the HP Booth. Phil also organized SEER '90 and the most amazing solar car rally ever!





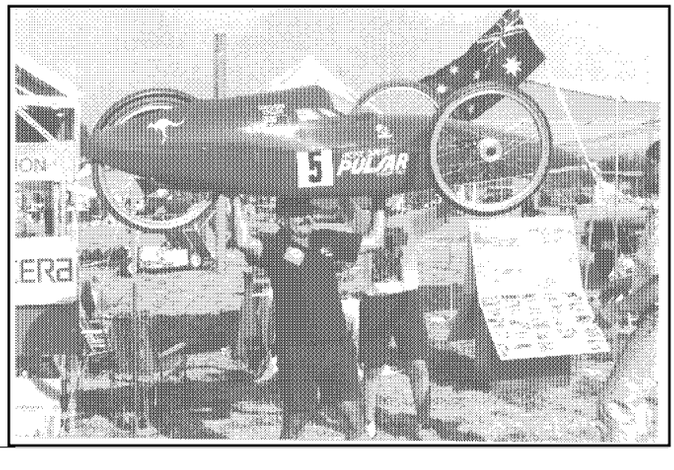
Above: James Worden and Solectria displayed a variety of electric vehicles.

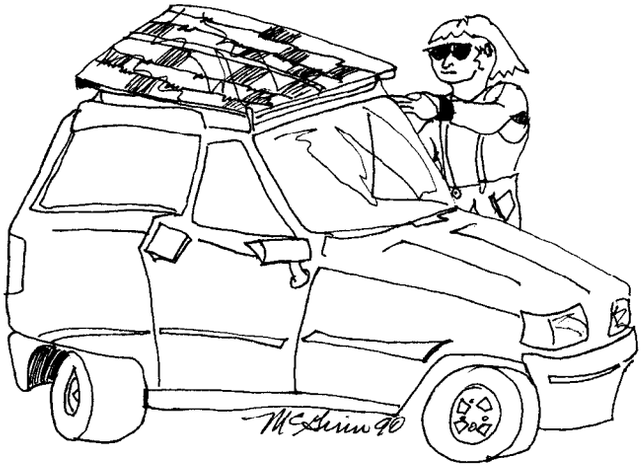


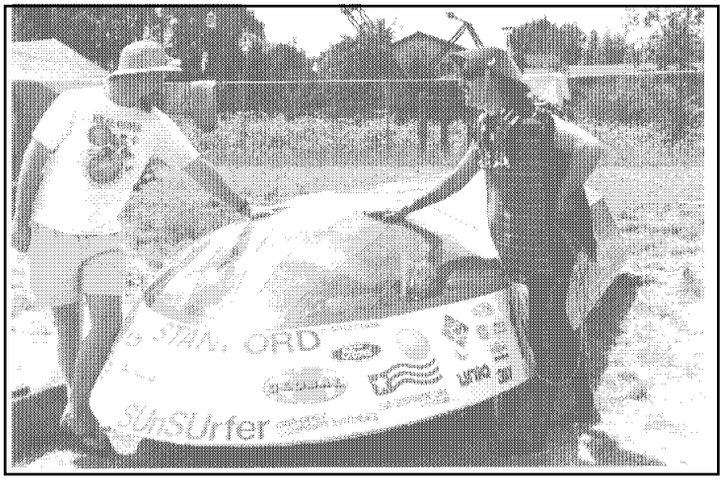
Above: some of the EVs looked fit for a journey into space as well as the local supermarket!

Photos by Richard Perez & Bob-O Schultze.

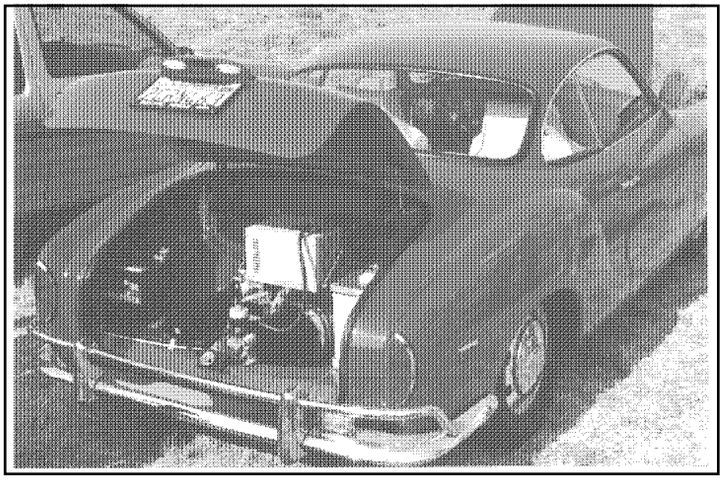
Left & Below: Clark Beasley's SlingShot electroracer was not only light in weight (that's Clark holding it on his head), but also too much fun to drive on the street (that's HP's editor Richard Perez at the wheel).







Above: John Schaefer of Real Goods (who sponsored this Stanford Solar Car) and PVMan pose before SUnSUrfer, a first place SEER '90 Rally winner.

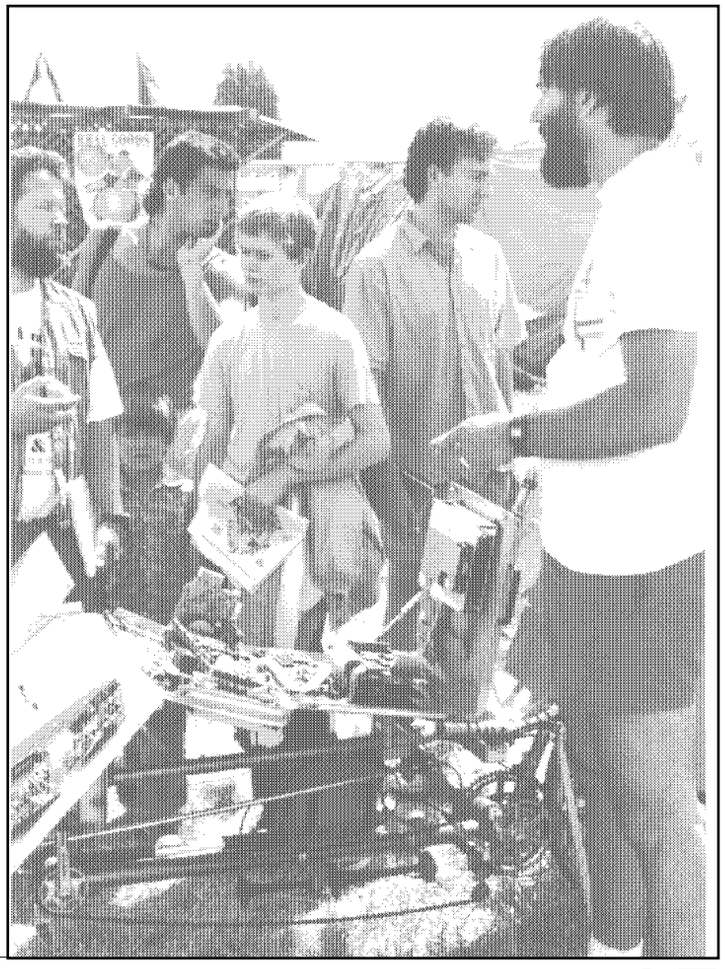


Above: this immaculate Volkswagen Karman Ghia won a first place for its perfect conversion to battery power.

Right: Steve Stollman explains his amazing bicycle to the crowd. This machine has a PV powered electric system that runs a Mac computer (and several other microprocessors), a complete amatuer radio station (including slow scan TV and packet), and all variety of radio gear and modems. Steve can type (he's an author and experimenter by trade) text into the Mac via keys on the handlebars. Steve's rode his self-built infocycle from coast to coast across America!

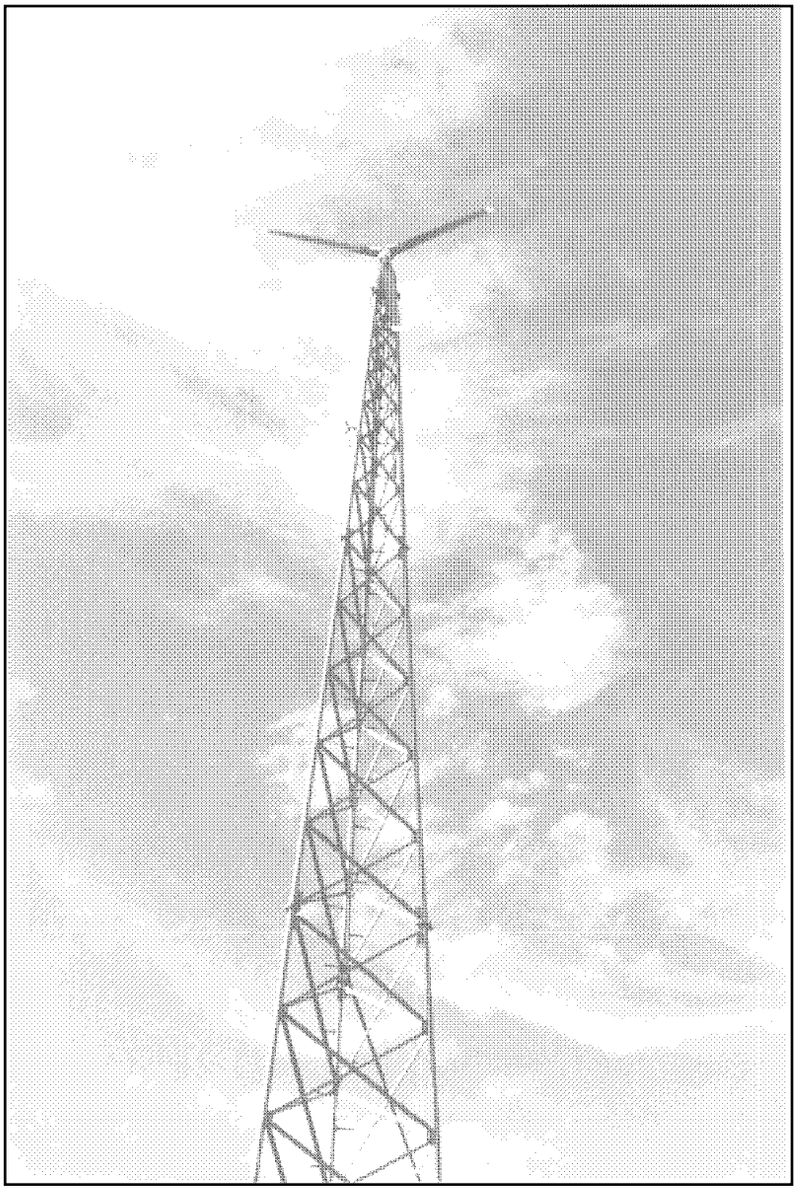
Above: this electrically powered Saab's liscense plate summed up the feelings of the over 30 EV drivers at SEER'90, "NOBIGAS" says the plate. Nuff said…

Photos by Richard Perez. Line Art by Patrick McGinn.



MREF

On August 17 through 19, 1990 the Midwest Renewable Energy Fair took place in Amhurst, Wisconsin. During the three day fair over 4,000 people entered the local fairgrounds to talk to 48 exibitors. There were more than fifty seminars on subjects like PVs, System design, Solar heating, Wind power, Hydro power, Batteries, Methane, Hydrogen generation & use. Wind and PVs supplied the power for the lighting, the PA system, and the nighlty music.



Perhaps the best way I can communicate the MREF Crew's comittment is to tell you about the wind machine. These amazing folks put up a working 2,000 Watt Jacobs wind system on an 80 ft. tall free standing tower-- just for the weekend! Mick Sagrillo, fearless leader of the wind project, hauled all this gear from Michigan to Amhurst with one anemic VW pickup. One tower section on top of the pickup, the Jacobs inside. The rest of the tower sections nested together, had an axle bolted to them, and then towed as a trailer behind the same VW pickup. I'm amazed.

The journey…

It's a long way from Oregon to Wisconsin. A long way. A very long way. Karen, Bob-O and I accomplished it in 42 hours of nonstop road burning. It was easy to find the fair, just look for the big wind machine on the tall tower.

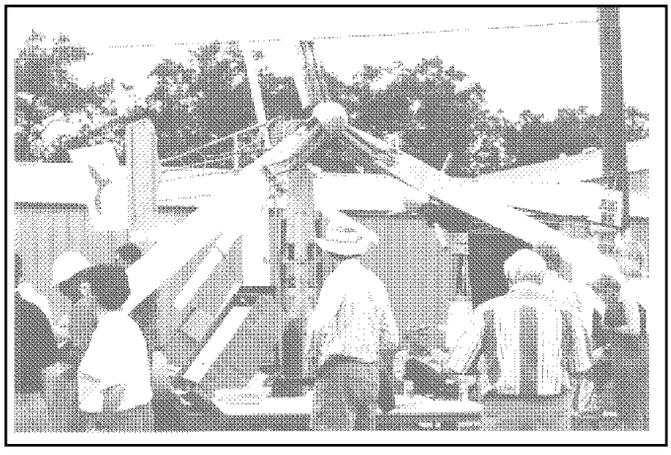
Immediately after the fair opened crowds gathered around the array of booths and tables. Folks came from everywhere with a hunger for renewable energy. These folks were well informed and had specific questions showing that they were experienced. No one once asked me how much hot water a PV panel made.

Wind Power Saves the Day!

With the stormy weather, the PVs weren't producing much power. The large battery was feeding all the fair's power. High on the tower the old Jacobs Windmachine gently whooshed the kWh into the batteries.

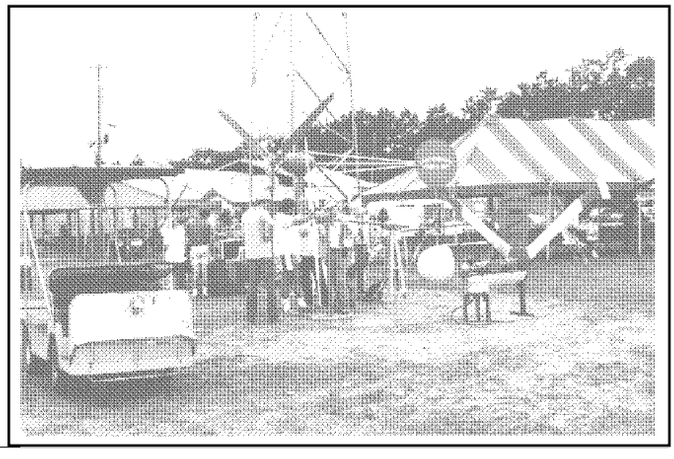
Saturday Afternoon

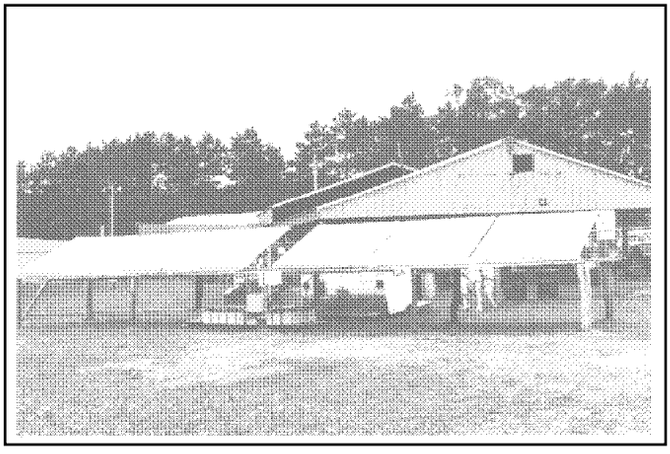
It began to rain buckets. Within an hour we experienced over 2 inches of rain. Everyone and everything was immediately and completely soaking wet. There would be no camping in



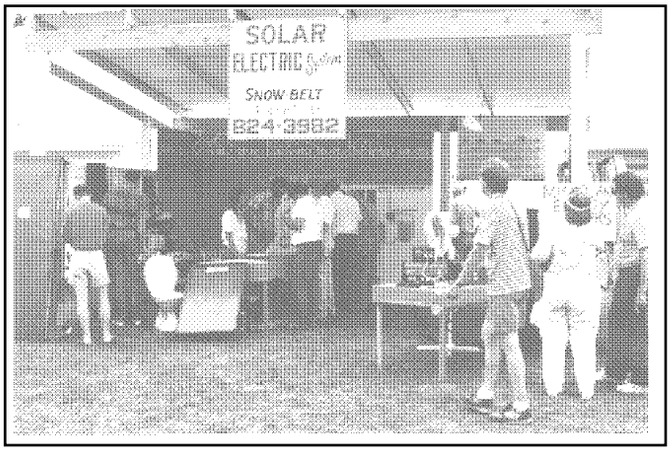
Above: crowds gather around one of the many wind power exhibits. This particular wind machine produces 20 kW. of power.

Below: more wind machines on display at the Lake Michigan Wind & Sun booth. The 1,000 watt Whisper machine is in the foreground. In the background are the footings of the 80 foot freestanding tower pictured at left. These folks are serious about wind power!

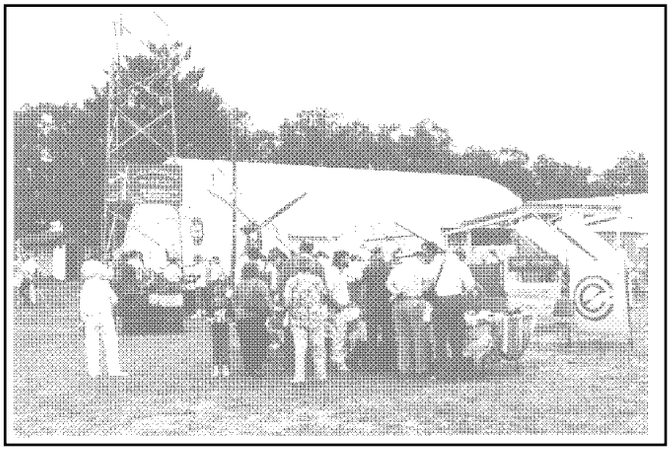




Above: the PV Array at MREF. While it rained cats and dogs during the fair, this array was functioning for days prior to the rain and had stored up power in its batteries for use on the stage and lightshow at night.



Above: the Snowbelt Solar booth, featuring solar DHW, efficient lighting, woodstove, and of course PV panels. The Snowbelt crew, especially Carol Welling, spearheaded the MREF.



Above: the Electron Connection & Home Power booths where Karen, Bob-O, and I were kept constantly busy meeting HP readers and all types of RE folks. No one minded the rain and the Fair went on wet or not!

Above: Wind Wizard, Mick Sagrillo, poses in front of a Zenith Windcharger. These early (≈1920) wind machines had only one job in life- powering the latest thing in technology - A RADIO!

the tent - it was floating in 4 inches of water and listing badly to starboard. We made a run for a motel, taking Conrad from Jordan Energy Institute's Solar Car crew with us. The local hostels must have been very pleased, between the rain and the fair, there was hardly a room available for miles. We slipped into dry sheets, sighing like wet rats under a warm stove.

Sunday Morning

Folks showed up at the fairground at dawn for breakfast. It was still raining and everyone was bundled up against the cold. Hot coffee, fresh fruit, and granola brought smiles and yawns. Ellen from the MREF crew made the finest wheat pastries any of us have ever eaten and they were HOT. I talked with individuals in the crew and more than a few wondered if the fair could go on that day. It was so wet and cold. Would anyone come? The group huddled in a circle and the doubts vaporized. As a group, the crew found the strength and courage of lions. The fair would go on! And on it went. Over eight hundred folks came to stand about pleasantly in the rain and discuss renewable energy.

We had a very fine time meeting these intensely interersting and active folks. The fair goes on again next year, and you can bet yer butt, the HP Crew will be there. We're thinking of a bus from the West Coast. Anyone interested?

Richard Perez

Using PV Panels to Recharge Small Nicads

Richard Perez

An appropriately sized photovoltaic panel can easily recharge those AA, C, or D nickel-cadmium cells. These "flashlight" sized batteries can be recharged hundreds of times and here's how to recharge them simply and cheaply using sunshine as the only power source.

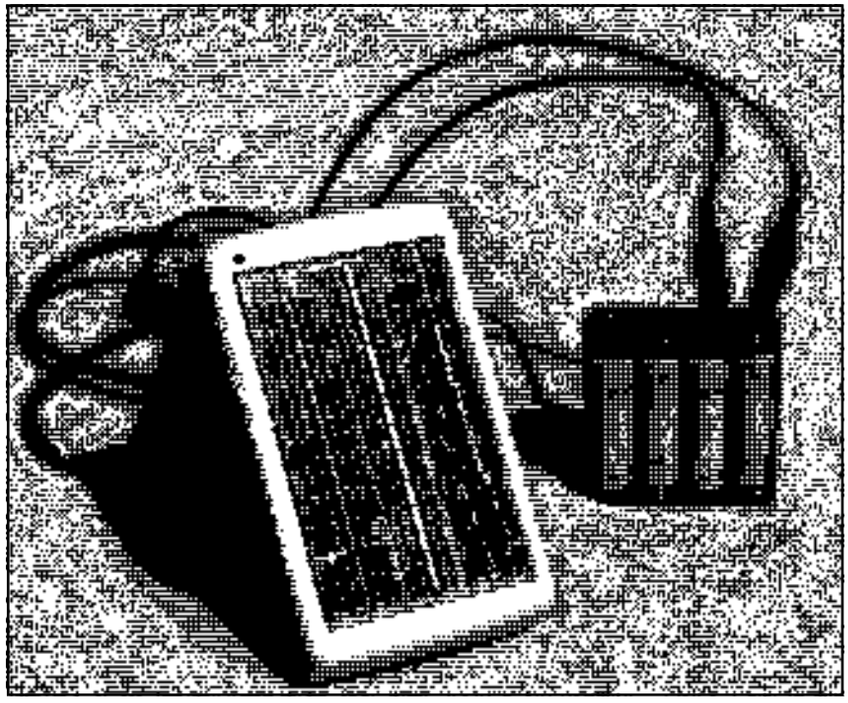
A quick look from the battery's point of view.
The small nicads used in flashlights, radios, tape machines, and many other battery powered devices are made in standard sizes: AA, C, or D. The AA model, in nickel-cadmium, contains about 500 milliAmpere-hours (that's .5 Ampere-hours) of power storage. C cells contain about 2 Ampere-hours, while D cells hold 4 Ampere-hours of power. All of these nicad cells have the same voltage operating range- 1.0 to about 1.3 Volts (rated at 1.2 VDC nominal). These small, sintered-plate nicad cells are differently made from the large, pocket-plate nicads we've been discussing in Home Power recently. When I speak of nicads in this article, I am referring to small, sintered-plate nicads in AA, C, or D sized packages. I am not refering to the larger pocket-plate types.

The standard recharging process for small sintered plate cells is to recharge them for 15 hours at the C/10 rate. C/10 means that the amount of current being fed to the cell is one tenth of the cells capacity. For example, a C/10 rate for a AA cell is 50 mA. (that's .050 Amperes), the C/10 rate for a C cell is 200 mA. (that's .200 Amperes), and the C/10 rate for a D sized nicad is 400 mA. (that's .400 Amperes). This process is called constant current recharging. This is because the cell is fed a constant amount of current for a specified amount of time. Most nicad flashlight type cells use the C/10 rate for current and 15 hours as the recharge duration.

Two, three, or more nicads can be charged in series. See the illustration below of series cells making up a battery. Since the battery is made up of only series cells, the amount of current flowing is the same for each cell. Thus, a series string of say, eight AA cells will be recharged at the same 50 mA. current rating as a single cell. The only difference is that one cell has a nominal voltage of 1.5 under recharging, while eight cells in series has a nominal voltage of 12 VDC while under charge.

Well, if all the nicad cells really need is constant current, then we need to introduce them to PVs which are constant current devices.

Photovoltaic cells as constant current rechargers.
The amount of current (Amperage) that the cell produces is directly proportional to the cell's size (surface area). Small PV cells make small amounts of current and large PV cells make large amounts of current. They all, regardless of size, make this current at the SAME voltage, that is one-half of a Volt. See the article on concentrator PV panels in this issue for more techie data on the relationship between voltage, current, and sunshine in PV cells.

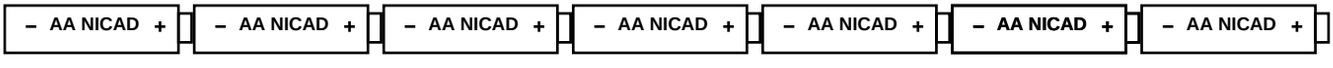


The JetSki at work recharging eight AA nicad cells.
Photo by Richard Perez

Since the current (Amperage) output of a PV cell is determined by its size, it is possible to produce a constant, limited amount current by choosing the right sized PV cell. Just what we need to recharge nicads!

The series interconnection scene with PV cells is the same as with batteries. Elements added in series produce a higher voltage of the array, but at the same current. Since PVs are constant current devices, if a PV module is loaded at a lower voltage, then the voltage of the module drops to the load voltage (in this case, a nicad pack) and the current still remains the same.

A marriage made in Heaven
We went to work finding a suitable PV panel (that's a series connected set of PV cells) for recharging AA nicads. AA nicads require 50 MA. of current, so the PV cells used in the panel must have just enough area to produce about 50 mA. of current. This means small PV cells made into a small PV panel. Voltage is really immaterial, just as long as there is enough voltage to do the job.



What we found was a PV panel of 36 series cells, each producing about 50 mA. The small PV panel will recharge anywhere from one to eight series AA nicad cells at the same time. Since the sun must be shining, it takes the JetSki about two days to recharge a AA nicad pack.

The return of the JetSki

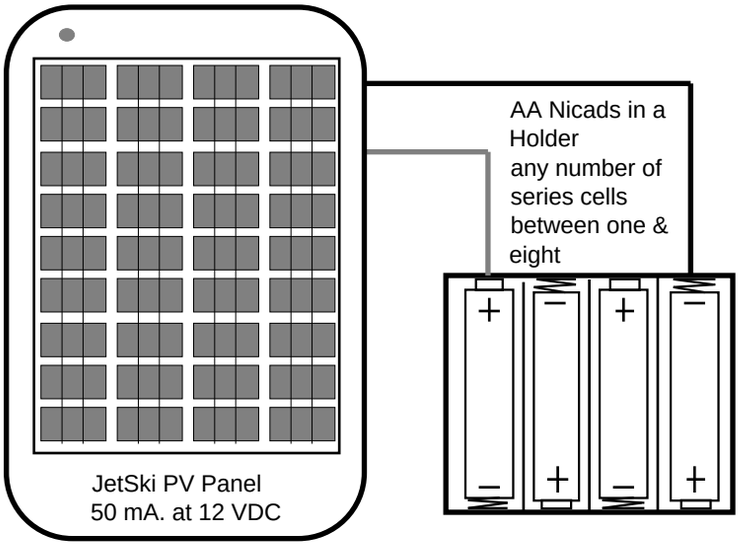
These PV panels are encased in weatherproof plastic. Their exterior dimensions are 5.4 inches, by 3.5 inches by 1 inch. It comes with about three feet of flexible, color coded wire firmly attached to the back of the module. The JetSki PV is as cute as a bug's ears!

These panels were originally made by Kyocera for a JetSki manufacturer, hence their rugged waterproof case and name. The PV cells used in the panel are the same polycrystalline type used in the J48 Kyocera modules. Same stuff, but the cells are much smaller. The JetSki has cells that measure .33 inches by .75 inches, while the J48s have cells that measure 4 inches by 4 inches. With 36 tiny PV cells in series, the JetSki is designed to work with 12 Volt systems. This means it can recharge between one and eight AA nicad cells in series. That's right, the very same charger will recharge one cell, two cells, three cells… up to and including eight cells at the same time. No controls, and no adjustments necessary. And it takes the same amount of time, two sunny days regardless of the number of nicads in the series pack! That's what we get from introducing a battery that requires constant current recharging to a power source that is truly a constant current source- simple, reliable, and easy performance.

The Recharging Process

The JetSki comes with two perfectly usable wires, one black and one red. The black wire is the PV panels negative connection and the red wire is positive. I soldered two alligator clips to the wire ends. I then inserted some empty AA cells in my Radio Shack AA battery holder (RS# 270-407 for $1.29), and clipped the PV panel to the battery pack. I have used this circuit to recharge everything from one to eight series AA cells. Note that the circuit doesn't use a blocking diode. It doesn't need one. The PV cells making up the JetSki panel don't leak enough current at night to be measurable by our very sensitive Fluke 87. Hence, no blocking diode needed.

I propped the JetSki up in the sun using the battery holder as a stand. This worked out well since the JetSki shaded the nicads and kept them cool. I separated the nicads from the JetSki in the photo so you could see each element clearly.



Now, the JetSki is the PV panel for recharging AA cells because it produces 50 mA. A perfect panel for C cells would produce 200 mA. The perfect PV panel for recharging D cells would produce 400 mA. The voltage of the panel is not important provided it has enough voltage to recharge the nicads. I like using a 12 Volt panel (that's 36 series PV cells) because it allows recharging of any number of series nicad up to and including eight. If a six Volt panel is used then only four series nicads can be recharged.

I leave the nicads connected to the JetSki overnight and let them finish recharging the next day. The nicads really appreciate have their recharging cycle broken into two segments with a night to cool off between recharging periods. If you space the cells out for an extra day and leave them under charge, no big deal. Most nicads can handle this gentle constant current overcharge with no problems.

Conclusion

This technique provides very trouble free nicad recharging. It can recharge any number of nicads from one to eight at the same time. No complicated or limited recharging apparatus needed. Just the right PV panel for the specific job at hand. And the whole setup is very portable, providing flashlight, radio, or what have you recharging in the field.

ACCESS

The JetSki's maker is Kyocera America, Inc., 8611 Balboa Avenue, San Diego, CA 92123 or call 619-576-2647.

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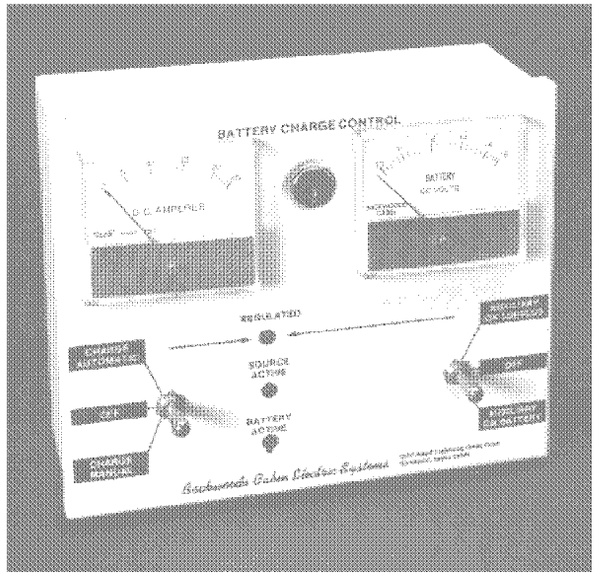

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ALTERNATIVE TRANSPORTATION NEWS

Michael Hackleman

Alternative Transportation News has the ambitious goal of changing the transportation habits of the world in this decade! It is designed as a full-color magazine so that it may popularize and educate the general public about transportation issues, alternatives to our current systems, and the means to achieve them. Through this magazine I would like to:

• advance the merits of rapid transit, low-polluting vehicles, alternative fuels, and telecommuting -- and ways we can implement them.

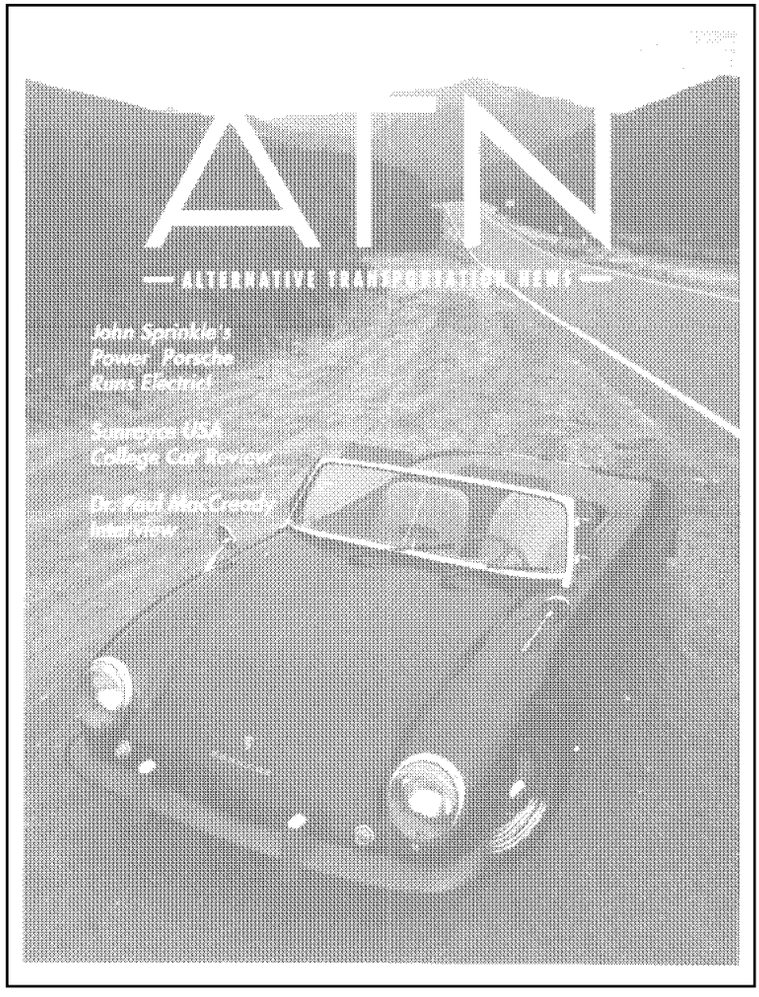
• unite a historical perspective with state-of-the-art technologies to suggest ways we can achieve transportation that is less abusive to life on this planet.

• describe how these products and technologies represent a fertile but virtually untapped market to individuals, entrepreneurs, and industry in general.

• translate otherwise technical information into terms anyone can understand.

• help individual organizations and corporations worldwide to become aware of each other's efforts in fuel and vehicle technologies -- and work together to integrate these efforts.

• provide a vision of the future without making promises on how easy, fast, or inexpensive it will be to extract ourselves from our dilemmas.



Why a Magazine on Transportation?

Over 75 percent of our nation's air quality problems is directly attributed to transportation. Our country is ready to wage war to protect our dependency on oil.

Americans want and need transportation alternatives. Currently, no publication for the popular audience deals with global transportation. ATN magazine aims to explore and demonstrate alternatives in an entertaining and engaging way. Our format will encourage, excite, and empower our readers with the ideas, visions, and information to affect changes in their own lives, and the world at large.

There are many groups, clubs, organizations, and companies across that nation that are currently engaged in some form of research, production, and promotion related to fuels and transportation technologies. ATN recognizes the dedication of these efforts, and wishes to publish articles that inform and illuminate projects that are underway.

A Sampling Of Articles In The First Issue Of ATN

The Impact: A prototype designed exclusively to use electric propulsion, the Impact shatters the myth of low performance and range. But -- how will GM market a vehicle that makes its gas-powered vehicles obsolete?

Racing with the Sun. Students from 32 Universities designed and built solar-powered race cars for the GM Sunrayce. Are the lasting impressions ones of hope and promise, or do these futuristic vehicles make EVs appear too expensive and impractical?

ATN interviews Paul MacCready. Paul's team has brought us successful human-powered flight, the winning entry of the first Australian transcontinental race of solar vehicles, and the design of GM's electric commuter. How does he do it?

Thunder & Lightning. Electric vehicle conversions? Low-performers, slow and limited in range? John Sprinkle's 1949 Porsche replica (cover photo) demonstrates how conversions can break that perception through forethought and patience.

The Horlacher Electric. With gasoline at $3-4 per gallon, there's plenty of incentive to explore alternatives in Europe. How can America catch up and take advantage of this technology?

Bicycling in the City. Drivers stuck in traffic jams fantasize about two-wheel transport but worry about the hazards of mixing-it-up with cars, trucks, and buses. Ben Swets made the switch and he's happy about it!

Airships. Lighter-than-air ships (blimps and dirigibles) are coming back. Advances in the technology make this form of aerial transport appealing in the light of increasing cost of fuels, maintenance, and pollution. But -- how can airships compete in a fast world and overcome the stigma of the Hindenberg disaster?

The SBLA battery. The Sealed Bi-polar Lead-Acid battery is just

one of several new battery types. ATN evaluates the critical issues about batteries -- what many experts consider to be the only roadblock to successful commercialization of electric vehicles.

EVs and Power Plants: Some environmentalists fear that the commercialization of electric vehicles will lend support to the resurrection of nuclear power plants. What energy sources can we expect to power electric cars?

Flying with the Sun: Eric Raymond's Sunseeker is an airplane designed to use one energy source -- the sun. Close attention to aerodynamic efficiency makes this electric-powered, solar-charged, thermal-riding craft possible. What does it tell us about the integration of down-to-earth energy systems?

Consider the various departments in ATN: Human-Powered Vehicles, Air & Water transport, Fuels & Cells, Nuts 'n Bolts, Designworks, Basic and Advanced Projects, and HindSight (History). Add sections like Library & Book Reviews, Calendar Events, and Networking. Provide for reader input -- From Our Readers, Questions & Answers, and Basics. With this breadth and depth, the magazine's field of topics seem limitless to me!

How You Can Help

Of course, this is OUR dilemma. If you share our feeling that this magazine is important, ATN's staff is asking for your help.

The simplest way you can help out is to take out a full year's subscription: 6 issues for $12. No matter what happens, you WILL get a magazine -- or a refund. Your subscription is a vote of confidence we could use right now.

There are other ways that individuals or companies can help us. ATN will be published by Earthmind, a California public non-profit research and educational corporation (founded 1972). Accordingly, all donations are tax deductible. This holds true for educational grants, PSA's (public service announcements), in-kind (equipment) donations, and research grants.

Advertising. ATN will contain ads. While advertising does not qualify as a tax-deduction, we do expect to reach a diverse audience. Our 3-issue rates are quite good. Contact us for a rate card, and other information on advertising rates.

ACCESS

The first issue of Alternative Transportation News could become a reality before the first of the year, 1991. We thank you, in advance, for your thoughts of support. Send subscriptions for ATN to: Earthmind, P.O. Box 743, Mariposa, CA 95338. (Checks payable to Earthmind). You may reach me, Michael Hackleman, at (213)396-1527.

Michael Hackleman is the author of Electric Vehicles: Design and Build Your Own, (1977) and the producer of the Hand Made Vehicles video series. He is the president of Board of Directors of Earthmind (founded 1972). Michael is also the president of the Electric Vehicle Association of Southern California and was a design consultant to (and a team member of) the Solar Eagle, a world-class solar-powered electric racer that won 4th place (out of 32 entrants) in the GM Sunrayce. Michael wrote the Hybrid-Configured Electric Vehicle articles for Home Power Magazine (Issues 8 & 9).

HOME POWER READER SURVEY

see page 31.

Help decide what Home Power will look like in the future

Rewinding Generators/ Alternators For Wind Systems

Mick Sagrillo

Wind generators run at fairly slow speeds: usually 250 to 600 rpm. Most people who design their own wind systems are stymied by the unavailability of slow speed generators. They usually choose to use an off-the-shelf generator that is stepped up to operating speed from the relatively slow propeller speed of a wind generator. But stepping up with gears, chains or belts introduces large inefficiencies, not to mention more moving components that need maintenance. There is another way around this problem: rewinding the alternator or generator for slow speed operation.

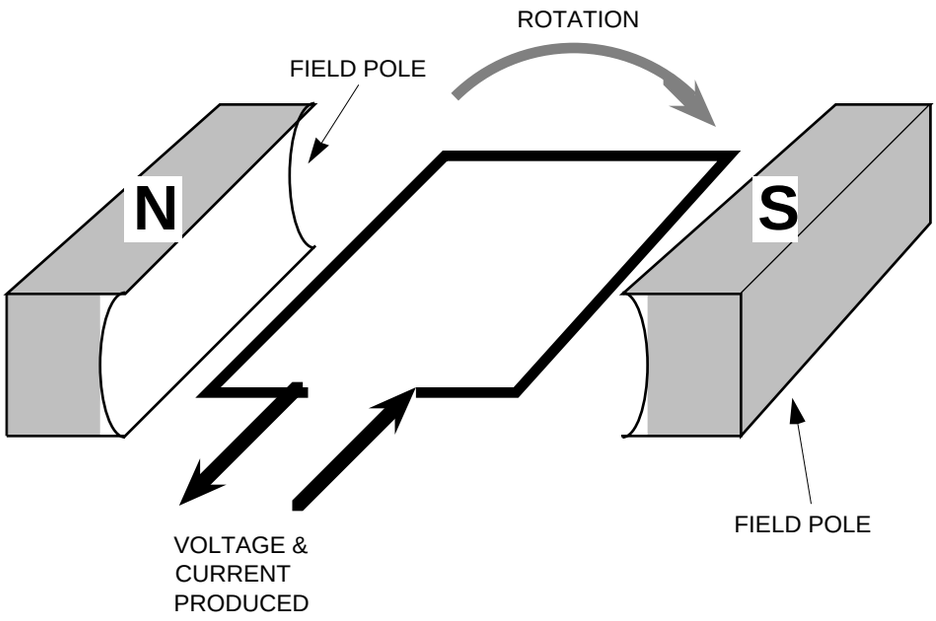


Figure 1. A generator is really wire moving within a magnetic field.

BASIC ANATOMY

In its simplest form, a generator or alternator is merely a coil of wire passing through a magnetic field, see Figure 1, above.

When our coil of wire passes through a magnetic field, voltage is induced in that coil (suffice it to say that this is something akin to magic). The voltage induced in the coil is proportional to the number of turns in that coil, the flux density of the magnetic field, and how rapidly the coil passes through the magnetic field.

The current generating coils of wire are called the armature in a generator and the stator in an alternator. The magnetic field poles are called the field in either device. In a generator, the armature rotates in the stationary field. because it is rotating, heavy-duty brushes must be used to carry the current produced from the armature. An alternator is an inside-out generator: the field, or rotor, rotates in the stationary generating coils, or the stator. Because an alternator's field uses very little current, the rotor needs much smaller brushes than does a generator armature.

RELATIONSHIPS

The design and construction of an alternator or generator is a considerable undertaking that could easily fill several volumes. However, there are several basic principles governing generators and alternators that we can use to our advantage in order to rewind an existing device for use at a slower speed. These principles incorporate the following generator characteristics:

- the RPM (speed)
- the number of poles
- the number of turns in a coil
- the magnetic flux density of the field
- the length of the armature or stator stack
- the airgap
- the current handling capacity of the wire

RPM & NUMBER OF POLES

All generators and alternators are designed to operate at a fixed optimum speed, called the operating RPM. This speed is what we wish to change to better match the operation of the wind generator propeller. One way of reducing the speed of a generating device is to increase the number of field poles. If you double the number of poles in a given generator, you will: (1) cut its operating speed in half for a given voltage: or (2) double the voltage output of that device at its operating speed. Unless you are building a generator from scratch, this is usually quite difficult to do. One exception is in a generator with main poles and interpoles. The interpoles can sometimes be converted over to main poles.

RPM & TURNS/COIL

The voltage induced in a coil of wire passing through a magnetic field is proportional to the number of turns in that coil. If we can double the number of turns in the armature/stator coils, we can either (1) double the operating voltage at a given RPM or (2) halve the operating speed of the generator at a given operating voltage.

RPM & FLUX DENSITY

Another way of increasing induced voltage in the armature/stator coils is to increase the magnetic field through which those coils pass. Field strength is related to the amount of current passing through the field relative to operating voltage; the more current you can push through the field coils (up to a certain point called saturation) the greater the flux density of the field. If we can increase the flux density of the field, the induced voltage of the generating coils will increase. Field strength can be increased by decreasing the number of turns in the individual field coils. The field coil uses up some of the electricity produced by the generating device. The ideal generator will use about five percent of its rated capacity in the field. Beyond this amount it becomes less efficient

to the point where saturation is reached and the field becomes parasitic. Field coils are usually connected in series in a generating device. One easy way to increase the current draw in a set of field coils without rewinding them is to divide them in parallel. This series/parallel arrangement still allows for north and south oriented poles.

INDUCED VOLTAGE AND ARMATURE/STATOR LENGTH

Yet another way of increasing induced voltage is by making the coils that pass through the magnetic field longer. Doubling the armature/stator stack results in a doubling of induced voltage.

AIRGAP

The amount of space between the field coils and armature/stator coils is known as the airgap. The airgap is necessary to prevent the coils from rubbing on the fields after both have expanded due to the heat given off by the electrical generating process. However, the airgap works against the flux density of the field: the greater the airgap, the greater the current needed by the field to overcome the airgap. Most alternators and generators have much larger airgaps than necessary due to sloppy construction. The airgap can be lessened by shimming the field poles with ferrous shimstock. The only way to do this is on a trial & error basis in small increments.

WIRE AMPACITY

The current output of the armature/stator is entirely dependent upon the current carrying capacity, or ampacity, of the wire used. Ampacity is related to wire size. Comparing relative wire sizes can be accomplished by comparing the wire's circular area (called circ. mils), unit weight, unit length, or unit resistance. The following chart

FIGURE 2: COPPER WIRE TABLE

Wire Guage	Circular Mils	Pounds/ 1000 feet	Feet/ Pound	Ohms/ 1000 feet
10	10380.0	31.430	31.82	0.9989
11	8234.0	24.920	40.13	1.2600
12	6530.0	19.770	50.58	1.5880
13	5178.0	15.680	63.77	2.0030
14	4107.0	12.430	80.45	2.5250
15	3257.0	9.858	101.40	3.1840
16	2583.0	7.818	127.90	4.0160
17	2048.0	6.200	161.30	5.0640
18	1624.0	4.917	203.40	6.3850
19	1288.0	3.899	256.50	8.0510
20	1022.0	3.092	323.40	10.1500
21	810.1	2.452	407.80	12.8000
22	642.4	1.945	514.10	16.1400
23	509.5	1.542	648.50	20.3600
24	404.0	1.223	817.70	25.6700

lists these relationships for wire sizes used in generators & alternators: Note that half sizes exist for most wire gauges but in the interest of clarity are not listed.

We have been talking about doubling the voltage or halving the RPM of a generating device by doubling the number of turns of wire in the coils. These coils fit into slots on the armature or stator. The slots have a given physical size that cannot be changed. Obviously, you can't fit more wire into a slot than it was designed for unless you use a lighter gauge wire. This is where the Copper Wire Table comes into use. If you wish to double the number of turns in a coil, you must halve the size of the wire. This corresponds to three steps down on the wire chart. For example, say we have armature coils with 7 turns of #15 wire. The circ. mil area is 3.257. One half of this would be about 1.6. This area is equal to #18 wire. The new coils made from 14 turns of #18 wire would fit into the existing slots.

Note, however, that by halving the size of the wire, you also halve the current carrying capacity of that wire. There is no free lunch! If you want a slower speed, you have to give up something. This new wire size will limit the power output of the rewound generator.

FER INSTANCE…

Let's say that we have a 1200 RPM, 32 VDC motor that we want to make into a wind generator, (DC motors & generators are more or less interchangeable). The motor draws 30 amps. We want it to run at a maximum speed of 300 RPM, and we'd like to power our hot water heater with the wind generator. The heating elements in the water heater are rated at 120 volts. We take the motor apart and discover that it has two main poles and two interpoles of the same physical size as the main poles. The wire in the interpole coils is finer than that of the main poles. We have pulled the armature apart and find that we have coils made of #10 wire with 4 turns/coil. What to do? Let's begin with the interpoles. If we rewind them to the same number of poles with the same gauge wire as the main poles, we have just doubled the number of poles in the generator. This has the effect of cutting the speed of the generator to 600 RPM, but still at 32 VDC. In order to get the speed down to 300 RPM, we need to double the turns of wire in the armature coils, from 4 to 8. Wire size is reduced from #10 to #13. But we're still at 32VDC! If we halve the wire size again, we're up to 64 VDC. one more time and we finally get to 128VDC, close enough! But we've taken two more jumps in wire size, from #13 to #16 to #19, and doubled the turns twice, from 8 to 16 to 32. Our final armature coils would then be 32 turns of #19 wire. What kind of current can we expect out of this generator? Doubling the field poles has no effect (in this case) on current. However, going to smaller wire gauge in the armature does. Going from #10 to #13 cut our current production from 30 amps to 15 amps. Two more jumps to #19 wire cuts our current output to 3 3/4 amps. Our wind generator will put out 4 amps intermittently at 120 volts with a top propeller speed of 300 RPM. This same process can be used in reverse to rewind a generator for lower voltage & higher current.

ANOTHER APPROACH

We have several old 12 volt, 100 amp Chrysler alternators in the scrap heap. We need an alternator for our hydro plant or wind genny to put out 24 VDC to match the PV array and inverter. New 24 volt alternators cost $400! What to do?

Car alternators possess several interesting features that can be used to our advantage. First, since we have several of these things, we have several lamination stacks at our disposal. If we take two of these cores, strip the wire and pop the rivets out, we can bolt them back together for rewinding. Since the lamination stack is doubled in size, we just doubled our voltage, from 12 volts to 24, without changing wire size. The same thing can be done with the rotor by merely feeding 24 volts into it. We'd need to use a 3-phase bridge rectifier in place of the usual voltage regulator. We can then proceed to rewind with different wire gauges to meet the RPM specs of our hydro or wind plant.

FOR THE LIBRARY

Anyone wishing more detailed information on rewinding can order the following republished out-of-print books from Lindsay Publications, POB 12, Bradley IL 60915. Both books cost $11.90 postpaid. Autopower, by S.W. Duncan, 1935 (Catalog #4791) LeJay Manual, by Lawrence D. Leach, 1945 (Catalog #20013)

ACCESS

Mick Sagrillo, Lake Michigan Wind & Sun, 3971 E. Bluebird Rd. Forestville, WI 54213 • 414-837-2267.

Harvesting Sunlight- Concentrator PV Modules

Richard Perez

Solar concentrators work like a magnifying glass- gathering light from a large area and focusing it on a smaller area. If that small area is a PV cell, then the power output of the cell increases. In fact, focusing two square units on sunlight on a one square unit PV cell will double the output of the cell. This two times concentration is called "two suns". If you put ten suns on a PV cell, then it will produce ten times the power. Here's some info on a concentrator that does NINETY suns! Sound like the free lunch? Hardly, it's just more effective use of our best natural resource- sunlight .

Concentrator PV Modules

Over the years many concentrating schemes have been used on PVs- most of them hopelessly high tech. The major problem is heat. When you concentrate sunlight , in addition to the visible and near ultraviolet portions, the infrared (heat) portion also gets concentrated. And PV cells don't like running hot. It reduces their output and shortens their lifetime. Most concentrator designs called for coolants, pumps, and heat exchangers. All adding complexity and expense to the system.

While at the Midwest Renewable Energy Fair, I was surprised to see concentrator PV modules that used no active cooling system. And it turns out that these concentrated cells are affordable.

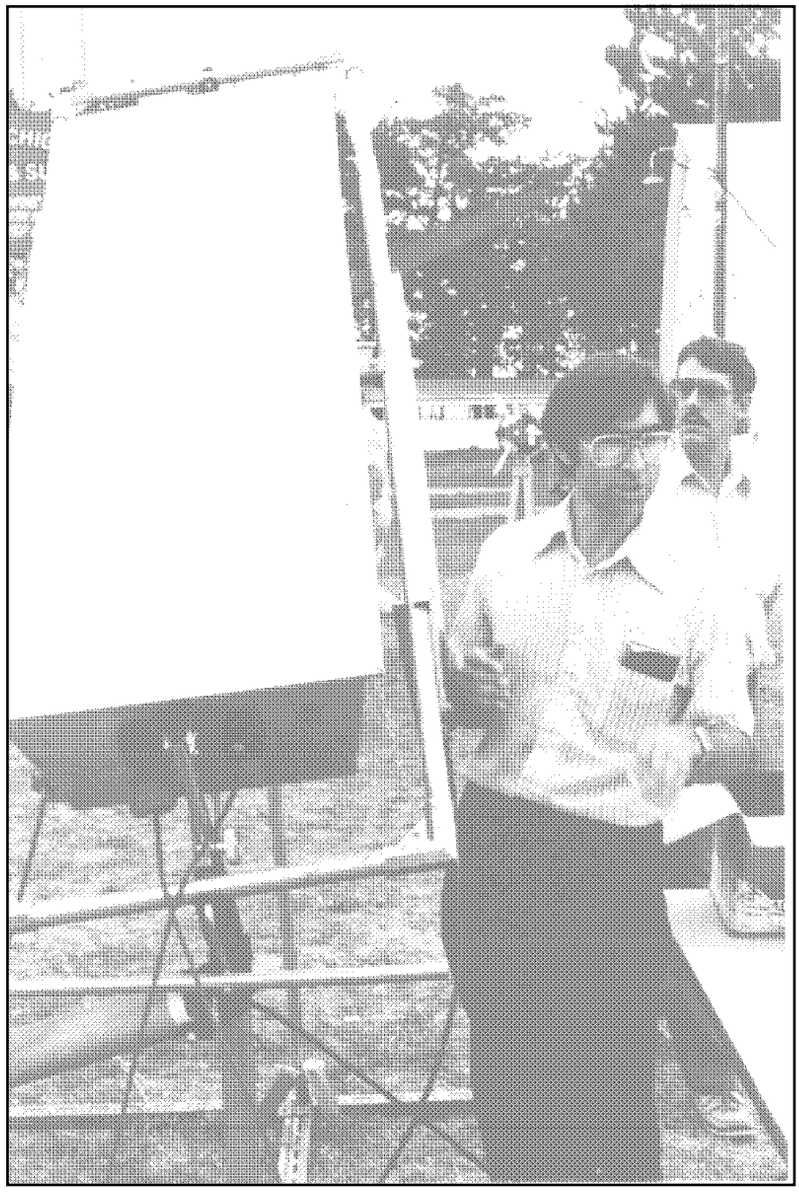
The Midway Labs Concentrator PV Modules

This design uses two stage optical concentration to achieve 90 suns on each PV cell. The first stage of concentration is an acrylic Fresnel lens (289 sq. cm. area) for each PV cell. The second stage of concentration is a glass lens, directly over the cell, which focuses the sunlight on a PV cell about the size of a silver dollar (0.79 inches in diameter). The PV cells used are single crystal silicon cells (made by Solarex or Astropower).

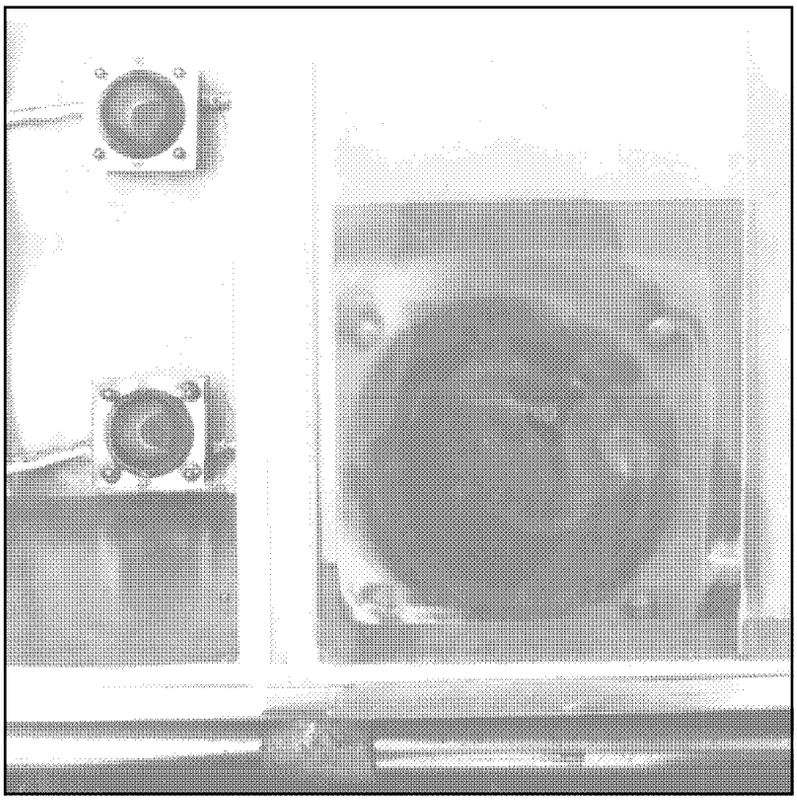
The PV cells are heatsunk to a welded aluminum framework that hold the cells and the concentrating optics. The entire array is actively tracked via a Robbins tracker. The equatorial mount tracks the daily east/west motion of the sun and also weekly changes in the Sun's north/south direction.

This Midway module, called the PowerSource™, measures 70 inches long, by 21 inches wide, by 11 inches deep. It produces 75 Watts of electric power (4.7 Amperes at 16 VDC). Up to ten of these modules can be tracked by a single Robbins active tracker. The entire works mounts to the ground on steel pipes set in concrete.

The economic advantage of concentration is more effective use of expensive highly refined silicon. The PowerSource module uses about 20 times LESS PV material than a conventional unconcentrated module. It also makes about 50% MORE power. The combined area of all the silicon PV cells in a single PowerSource module is about 30 square inches and it generates 75 Watts. The combined cell area in a conventional PV panel is about 575 square inches of expensive hyperpure silicon to produce about 50 Watts of power. Since highly refined silicon is the most expensive component in PV panels, concentrating sunlight pays off big time in lower cost per watt.



Above: Paul Collard of Midway Labs displays a single PowerSource™concentrated PV module at the Midwest Renewable Energy Fair. The PowerSource uses 20 times less PV material than unconcentrated modules. It also makes 50% more power than unconcentrated modules. All this results in low cost, about $5.00 per Watt.



Cost of Concentrating

Consider an average (cycling 5 to 6 kiloWatt-hours daily) home system which requires a PV array with peak power of 750 Watts. The cost of using ten PowerSource modules, and their active Robbins tracker is about $4,500. The cost of an equivalent conventional setup- tracked, but unconcentrated, 750 Watt PV array (≈15 panels) is about $5,700.

While I haven't yet tried the PowerSource and compared its performance with other more conventional PV setups, I am eager to do so. Midway Labs' warranty on the PowerSource is ten years. If in fact, the PowerSource lives up to its maker's claims, then concentrating and tracking PV arrays will become less expensive than conventional arrays.

Access

Richard Perez. C/O Home Power, POB 130, Hornbrook, CA 96044 • 916-475-3179.

The PowerSource™ is made by: Midway Labs, 2255 East 75th St., Chicago, IL 60649 • 312-933-2027.

Left: these PV cells are all the same size and mounted on the bottom of the concentrator. The one on the right looks big because we are viewing it through the Fresnel lens concentrator. The two on the left are viewed directly (Fresnel removed) and their secondary lenses are visible. Each cells is about the size of a silver dollar. Note heat protection on the wiring.

Report on the Inverter Shootout at SEER '90

Richard Perez

Seer '90 at Willits, CA was probably the very first time that this industry had just about everyone in the same place at the same time. A perfect opportunity to place different brands of inverters in exactly the same system and compare their performance under a variety of loads.

The Test Inverters & People

Just about every inverter manufacturer got into the act. Inverter manufacturers present were (listed alphabetically) Heart, Heliotrope, Photocomm, Statpower, and Trace. We were only able to test the 600 Watt inverters (Heart 600, Statpower 600, & Trace 600) because of system limitations. So the larger (>1 kW.) inverters made by Heart, Heliotrope, Photocomm and Trace were not able to be tested, but in all fairness they were ready and willing. The reasons why we couldn't test the larger inverters was voltage loss through the system's cables, fuses, switches, circuit breakers, shunts and connectors. More on this problem below.

The testing was organized by the fine fellows from ATA, Johnny Weiss and Ken Olsen. The testing was conducted on Sunday August 12, 1990 in front of a live audience of more than 50 fairgoers and the tech reps from the aforementioned inverter manufacturers. The whole show was video taped by Paul Wilkins of The Photovoltaic Network News (PVNN).

The Test System

The test system contained eight Trojan L-16 lead acid batteries configured as a 1,400 Ampere-hour battery at 12 Volts DC. The system contained lots of other gear like eight PV models on a Zomeworks tracker, regulators, controls and instrumentation. We hunted through the crowd and were able to find three Fluke 87 Digital Multimeters to take accurate test data. All inverters used the same set of heavy weight copper cables for connection to the system. A large board of 100 Watt incandescent lightbulbs served as loads. Other loads tried were an approximately 650 Watt Microwave oven and a medium sized (about 400 Watt) circular saw. These last two loads were used to measure the inverter's performance under inductive loads.

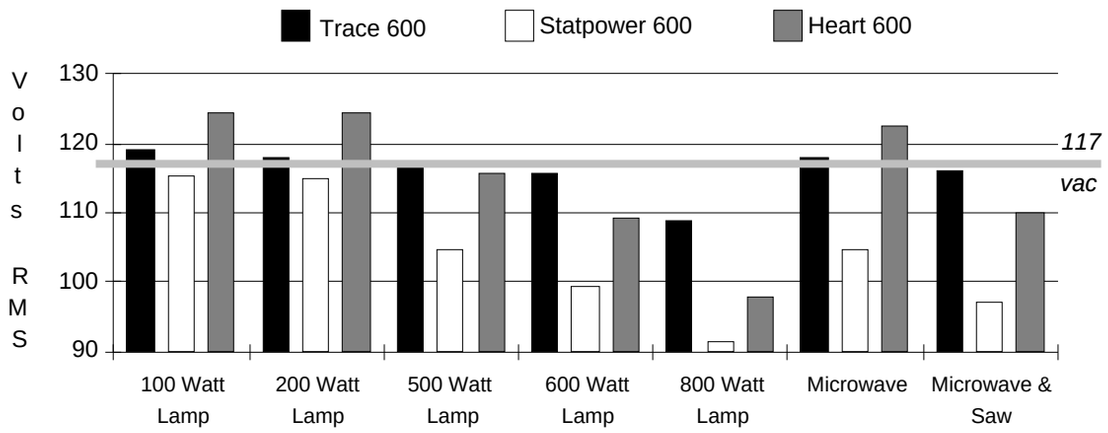
The Data

The table and chart below give the data just as it was taken. All inverters were run into exactly the same loads. The most meaningful data was the output voltage of the inverter under a variety of loads. We measured RMS voltage and peak voltage of the inverter's output. We also measured battery voltage, amperage, and inverter frequency. In terms of battery voltage and amperage, it became apparent early on in the testing that the instrumentation was not accurate, so I have omitted this data from the table and chart. In terms of frequency, all the inverters were so stable and close to 60 cycles that the data was trivial. Copies of the data were supplied to all the manufacturers of the inverters immediately after testing.

In order to match the output of the commercial electric grid, the inverter should have an RMS voltage output of 117 volts ac. RMS voltage on the grid commonly varies by about six volts RMS or about ±5%. Peak voltage of the commercial power grid is 162 volts peak. Since inverters don't really make sine wave power, their peak voltage is different from that of sine wave grid power. The peak data is, however, accurate and provides a basis for relative comparison of inverter performance. What really counts in the inverter test data is how close the inverter was able to keep its output voltage to 117 volts RMS under a variety of loads and within its specified operating range of 600 Watts.

600 Watt Inverter Shootout, Willits, CA on 12 August 1990

120 Vac Loads	TRACE 600 Vac RMS	TRACE 600 % High or Low	TRACE 600 Vac PEAK	STATPOWER 600 Vac RMS	STATPOWER 600 % High or Low	STATPOWER 600 Vac PEAK	HEART 600 Vac RMS	HEART 600 % High or Low	HEART 600 Vac PEAK
100 Watt Lamp	118.9	2%	141.2	115.2	-2%	148.0	124.4	6%	148.0
200 Watt Lamp	118.1	1%	136.8	115.0	-2%	148.8	124.2	6%	140.8
500 Watt Lamp	116.7	0%	125.2	104.6	-11%	137.6	115.8	-1%	122.8
600 Watt Lamp	115.8	-1%	123.2	99.3	-15%	130.8	109.2	-7%	115.6
800 Watt Lamp	108.9	-7%	116.8	91.5	-22%	122.4	98.0	-16%	104.0
Microwave	118.0	1%	140.8	104.7	-11%	141.2	122.6	5%	221.6
Microwave & Saw	116.0	-1%	181.2	97.0	-17%	142.4	110.1	-6%	191.2



Conclusions from the data

I am content to let the data speak for itself.

Now this test system was set up according to Code. This means that it had all the fuses, circuit breakers, fused disconnects, and other paraphernalia required by the National Electric Code (NEC) in addition to the cables and connectors necessary to move the power from the batteries to the inverter. The major problem we had testing the larger (over 1,000 Watt) inverters was voltage loss. By the time all the code required safety devices added their individual voltage losses, we couldn't move much more than 100 Amperes of current into the inverter. At amperages higher than this, the accumulated voltage loss of all the components in the inverter's low voltage supply lines was about 2 Volts. This meant that the larger inverters were shutting themselves off because of low voltage at their terminals.

And this is perhaps the most important thing we learned from this testing. Large inverters are capable of drawing surges of well over 1,000 Amperes from the batteries. They are capable of consuming over 200 Amperes during normal operation at their power limits. In order for a low voltage line to move this much current without excessive voltage loss, the line much have very, very low resistance. The inverter lines at SEER '90 had a resistance of about 0.02 Ohms. This was too much resistance to operate an inverter larger than 600 Watts. Today's inverters commonly put out over 2,000 Watts. In order to have these larger inverters work well, the electrical lines feeding them must have very low resistance (less than 0.0015 Ohms). This means heavy copper cables of between 0 gauge for cables totaling less than 6 feet, to 0000 gauge for longer cable lengths. Every series connection and device in this low voltage line adds some resistance. Every fuse, fuse holder, mechanical connector, circuit breaker, switch, and disconnect adds some resistance.

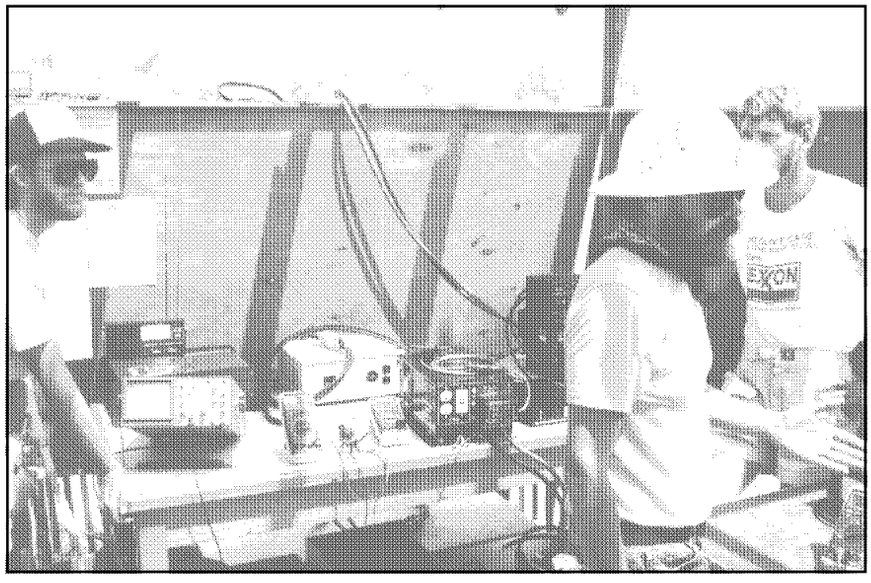
I appreciate that the NEC is concerned for our safety and the safety of our systems. My concern is that by the time they've made us safe enough, our system will be crippled by the accumulated voltage losses in all the protective devices. Please understand that I am all for safety and agree that we need protection in low voltage lines. I respectfully submit that the NEC needs to spearhead the development of safety devices (like fuses, fuse holders, disconnects and circuit breakers) that have about ten times less loss than those they are now proposing. The NEC and the electrical products industries are used to working with 120 vac where a volt or two loss doesn't make much difference to performance. In 12 Volt systems, however a volt or two loss is the difference between working and not working. If low resistance protection devices are not developed, then we are faced with two choices: 1) running an outlaw system, or 2) sitting safely in the dark.

ACCESS

I am happy to communicate with anyone about inverters, systems, batteries, etc: Richard Perez, C/O Home Power, POB 130, Hornbrook, CA 96044 • 916-475-3179.

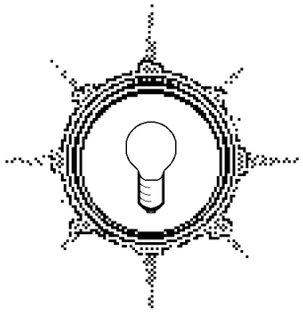
The ATA guys, Johnny Weiss (in the SEER T-shirt and Solar Balaclava) and Ken Olsen (in the cowboy hat) oversee the main power panel of the Solar Demo House at SEER '90. This power panel interfaces with eight L-16s and a tracked rack of eight PV modules. It contains all NEC stuff like disconnects, circuit breakers, fuses and distribution panels. The power center also has a 2 kW. wall mounted Heart inverter.

Photo by Paul Wilkins



The 600 Watt inverter test setup. All inverters were tested on the same set of cables connected to the same battery. All measurements were taken with the inverters under identical loads. Instruments used were three Fluke 87 digital multimeters and an oscilloscope.

Photo by Paul Wilkins



Agate Flat, Oregon

23 September 1990

Dear Home Power Reader,

Home Power is your magazine. We try to publish what you want to see. From new renewable energy technologies to basic electricity to electric vehicles, we try to provide the easy to digest technical information that you have requested.

The information flow here at Home Power is truly amazing. We are receiving about three times more great information that we can cram into a 68 page issue of Home Power. We've stopped actively pursuing advertisers because in a 68 page issue, the amount of advertising we now have is about 28% of the magazine. To take on more advertising would mean less space for content (most magazines are more than half advertising, check it out).

We need to expand Home Power to transfer more information, more quickly.

Home Power's main goal is not business. Karen and I aren't in it for the money. We are doing this to spread the word that renewable energy technologies can easily be applied by folks on a budget. Our mission is to convey the technical details of renewable energy technologies in an easy to understand fashion. This leads folks to doing it rather than just reading about doing it. We, RE users, need this information, and so does our planet. In order to spread the word about renewable energy, Home Power is now appearing on news stands and in bookstores across America.

Is it time to expand Home Power with more pages, post consumer recycled (non-glossy) paper, the use of less toxic soy bean based inks throughout, and color photos on the cover? The ink in this issue is all soy based (yes, the color, too), an example of what we are discussing. For more inside HP details about suchlike, see Ozonal Notes on page 62 of this issue.

Part of the problem is that post consumer recycled paper is not available in the paper we are now using for the main body of Home Power. This means that we either have to use regular newsprint or upgrade to a heavier paper. Going to the heavier paper not only increases the cost of production but also the mailing costs. Reproduction quality on the heavier paper would be much better, especially on the photographs.

This is an open letter to you about Home Power. What kind of magazine do you want to read in the future? Please help us do what is right with what is after all, your magazine. Here's some specific questions about the directions we are going. Your input would be greatly appreciated. Please fill in the blanks and write any comments you may have on the remainder of this sheet of paper. Fold it up, tape it, put a 25¢ stamp on it, and drop it in the mail to us.

So, what do you think? Should Home Power stay small and continue to be an "insider's" type publication, or should we try to hit America (nay, the whole World!) between the eyes with the fact that: " **if we can do it, then so can you**".

The results of this survey will be published within 60 days, in the next issue of Home Power.

Energetically,

Richard & Karen for the Whole HP Crew

Should Home Power have more pages per issue?

YES ☐ NO ☐

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YES ☐ NO ☐

Should Home Power have color photographs?

YES ☐ NO ☐

If Home Power were 90+ pages of recycled high quality paper, with color printing, what would a yearly subscription be worth to you? (Please enter a dollar amount)

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For those wishing **Back Issues of Home Power for $2 each, or international subscriptions**, please see **page 63**.

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HP#19

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☐	☐	**Water power generator**	☐	☐	**Inverter**
☐	☐	**Battery Charger**	☐	☐	**Control systems**
☐	☐	**Instrumentation**	☐	☐	**PV Tracker**

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HP#19

SOLAR DOMESTIC HOT WATER

Todd Cory

Heating water with the sun is very practical and cost effective. While photovoltaics range from 10-15% efficiency, thermal water panels range from 50-80% efficiency. In combination with a wood stove coil/loop, virtually year round domestic hot water can be obtained without the use of fossil fuels.

DESIGN

Solar water heating panels consist of parallel vertical pipes attached to an absorber plate with horizontal header pipes at the top and bottom. All of this is enclosed in an insulated box with a tempered glass cover. A heat transfer fluid circulates through these pipes to the DHW (domestic hot water) storage tank. I have made several panels myself with little difficulty. While not as efficient as commercial units, the cost savings make home construction worthwhile. Most commercial units come in 4x8' or 4x10' copper with black paint or chrome finish. A high quality 4x10' black chrome absorber panel can produce about 45,000 BTU's per day. One BTU is the amount of energy required to raise 1 pound of water 1 degree F. Current cost for such a panel is around $600. As a large part of these panels is made of copper, prices will vary with the market price of this metal.

SIZING

As with electrical production the system must be sized to the user's needs. Comparing the parallels with electrical production may make sizing easier to understand.

- BTUs gained per day≈watt hours of charging
- Storage in gallons of water≈amp hours of battery storage
- Usage in gallons of water≈amp hours of load

Here are some things to consider when sizing (gallons of usage per day) your DHW system.

- Numbers, length and temperature of showers/baths per day
- Future or present hot tub heating requirements
- Future or present hydronic heating requirements

An "average" (HOME POWER readers would most likely consider this excessive) household of 2-3 would need a minimum of 50 gallons of storage and 1 4x8' (32 sq. ft.) of absorber panel. This is strictly ball park. Usage needs will determine system size.

STOVE LOOPS

Unlike solar electric systems, sun/heat energy can also be transferred by a coil/loop inside the wood stove. You can make your own out of steel or copper pipe or purchase a much superior unit made of stainless steel from the folks at Hydrocoil in Grass Valley, Ca. By incorporating solar hydronic panels on the roof for production in the summer months and a wood stove loop for the less sunny winter months, domestic hot water production can be maintained year round, and storage tank capacity reduced.

PLUMBING CONFIGURATIONS

Basically there are 5 variations of plumbing arrangements in solar DHW systems.

1) DRAIN DOWN (active pumped)
2) DRAIN BACK (active pumped)
3) CLOSED LOOP (active pumped)
4) PASSIVE CONVECTION (tank on roof type)
5) PASSIVE PUMPED ("geyser" type)

The main concerns in choosing a system type are:

1) availability to operate active pumps and electronic controls
2) amount of below or near freezing weather in your area
3) efficiency and maintanence requirements of design

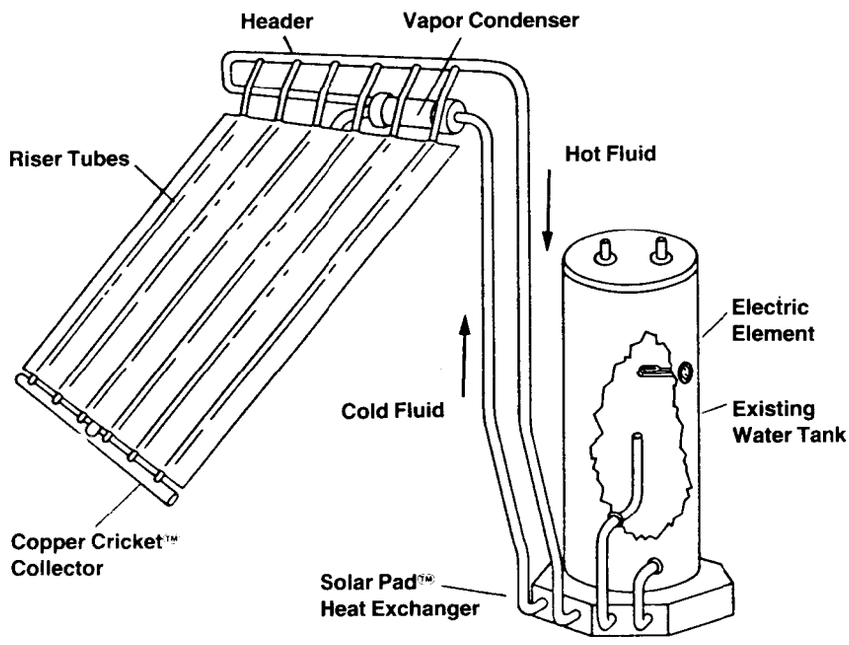
Below follows a brief description of each plumbing arrangement with advantages and disadvantages for each.

1) DRAIN DOWN

When the control senses heat available to be gained, an "HG-SPOOL" (drain down valve) opens, filling the panel(s) and operating a pump, which circulates potable water directly from the DHW storage tank through the panel(s). When temperatures approach freezing, the "HG-SPOOL" closes, draining the remaining water from the panel(s) to the ground.

On the Plus Side

- Most efficient as the system uses potable water in the panel(s) directly, without the need for heat exchangers
- Existing/standard DHW tank can be used



On the Minus Side
• Needs HG-SPOOL, vacuum breaker, air vent and control all subject to eventual failure, resulting in destroyed panel(s) in freezing weather and costly repairs.
• Needs power from the electrical system to hold the HG-SPOOL open and to operate the pump and controls.

2) DRAIN BACK
When the control senses heat available to be gained, the pump is activated, circulating distilled/treated water through the panel(s) and a special heat exchanger within or external to the DHW storage tank. A drain back tank holds this water when it is not being pumped through the panel(s).

On the Plus Side
• High efficiency as a non-toxic heat transfer fluid is used
• Low freezing potential as the panel(s) are drained by gravity when there is no heat to be gained.

On the Minus Side
• Needs electric power to operate the pump and controls.
• Needs special drain back tank
• Needs heat exchanger/storage tank or external heat exchanger.
• Some noise when the pump is moving water through the system.

3) CLOSED LOOP
The panel(s) are filled with a non freezing heat transfer fluid. Common fluids are propylene/ethylene glycol, or silicon oil. When the controls sense heat available to be gained, the pump is activated, circulating the fluid through the panel(s) to the heat exchanger, where it heats the potable DHW.

On the Plus Side
• Virtually eliminates ANY freezing potential.

On the Minus Side
• Heat transfer fluid (glycols) must be changed every 4-5 years to maintain PH.
• Needs heat exchanger/storage tank or external heat exchanger.
• Needs electric power to operate the pump and controls.
• Only medium efficiency- non potable heat transfer fluid is used.

4) PASSIVE CONVECTION (tank on the roof type)
The DHW storage tank sits on the roof above the panel(s). The panel(s) contain a non freezing heat transfer fluid which passively convects to heat the potable water in the DHW storage tank.

On the Plus Side
• The wood stove coil/loop is easily installed in a passive fashion as the DHW storage tank is on the roof.
• System is totally passive.
• Medium high efficiency as the panel(s) are so near the DHW storage tank and a non-toxic heat transfer fluid is used.

On the Minus Side
• ALL pipes must be WELL insulated to reduce freezing potential.
• Some use the unevironmental CFC freon in the convection loop.
• If gylcol is used in the convection loop, it will need to be changed every 5 years to maintain PH.

5) PASSIVE PUMPED (geyser type)
The DHW storage tank sits on a pad which convects heat from pumped fluid in the panel(s) to the potable water. The heat from the sun does the pumping to this heat exchanger which can be located as much as 36 feet below the panel(s). (see HP #8 Page 20)

On the Plus Side
• No possibility of freezing.
• System is totally passive.

On the Minus Side
• For use of this system with a passive (convection) stove loop, the DHW storage tank must be a minimum of 15" above the stove.
• Medium efficiency- uses an alcohol heat transfer fluid.

CONCLUSION
All systems are adaptable to inclusion of wood stove coil/loops. In areas where freezing weather is common, the drain down type is not advisable. For people using alternative electrical energy, any active type system (drain down, drain back,closed loop) is also not advisable. This leaves us with two types of passive systems. The geyser pumped type and the convection tank on the roof type.

My personal favorite is the passive convection type, particularly, Solahart's 300 L-J. It incorporates an 80 gallon storage tank and 2 (3 optional) 4x6' black chrome absorber panels. It produces the maximum for any such passive roof mount unit of 35,800 BTUs per day. With installation (without wood stove loop) one could expect to pay around $2,100. Its nearest competitor, the Suncatcher II uses the ozone destroying CFC, freon, (Solahart uses non-toxic propylene glycol) as a heat transfer fluid. It has a 40 gallon storage tank, produces 14,500 BTUs per day and with installation (without wood stove loop) one could expect to pay around $1600. The Solahart is easily adaptable for use with a passive wood stove loop, which also greatly reduces freezing potential. I've worked with Solahart on several of their units in Mt. Shasta and they really stand behind their products. They've been in the business for over 30 years and when in Australia in the early 80's, I was amazed to see them on nearly every roof.

As to the geyser pumped type, I have little experience with them. It is a relatively new design and while the manufacturer rates them highly, field testing has shown some sensitivities to exact charging techniques. Also, the system utilizes an alcohol heat transfer fluid which, from what I understand is less efficient than glycol based heat transfer fluids, which in themselves are inherently inefficient. I would welcome further field based reports on this system.

For two years I installed/maintained solar hot water systems in Mt. Shasta with Chitwood Energy Management. We did mostly closed loop ethylene glycol systems to eliminate any freezing potential and as grid power was available. Regardless of the system you choose, Solar DHW, like solar photovoltaic electricity, is the way of the future. As with PV's for folks at remote locations, it is NOW a cost effective means for abundant year round running hot water. I would be happy to answer further questions/inquiries regarding DHW solar systems. Please include a S.A.S.E.

ACCESS

TODD CORY, PO Box 689, Mt. Shasta, CA 96067

SOLAHART, 11855 Sorrento Valley Road, #B, San Diego, CA 92121 • 800-233-7652 • 619-481-9941

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HELIOTROPE GENERAL (HG-SPOOL), 3733 Kenora Dr., Spring Valley, CA • 800-522-8838 in CA • 800-854-2674 out CA

HYDRO COIL (stainless steel wood stove coils), 14340 Dandee Hill Rd., Grass Valley, CA 95945 • 916-272-4904

SAGE ADVANCE CORP. (Copper Cricket), 4209 West 6th Ave Suite A, Eugene, OR 97402 • 503-485-1947

CHITWOOD ENERGY MANAGEMENT, 508 Sarah Bell, Mt. Shasta, CA 96067 • 916-926-3539

LOW VOLTAGE COMPUTING

John C. Osborne

Do computers make sense in home power environments? YES! Computer use has high potential rewards and its cost is easily justifiable. While the effort is worth it, the methods aren't obvious. This is the first of a series of columns explaining why and how to run computers directly from low voltage DC. Lets begin...

WHAT IS A COMPUTER?

A computer is a universal information processing machine. It is mankind's most complex and open-ended tool. Software is the instruction list for re-arranging the computer "wiring", making it a different machine for different tasks. Software tells the computer what to do. The computer can be a calculator, word processor, database, PacMan game or whatever you want or invent.

ARE YOU AN EXPERT?

YES, you are an expert in your chosen field. Example: Authors write better copy than word processing gurus. Sure, experts build computers, but we advance by standing on the shoulders of others. Layer your special knowledge on theirs. Do not be intimidated.

House Keeping

Gone are the days of keyboarding indecipherable codes, symbols and abbreviations. New programs called Graphical User Interfaces (GUI) let you point and click. Pictures represent your data. Menus display available choices. Complex, tedious details are made visible, easy, fast and fun. The manuals are built into the programs, many never use the printed manuals.

Shrink-Wrapped

This term means mass-produced, commercial software packages. Hundreds of man-years in development, mass marketing keeps software prices dirt cheap relative to their power. Very few people program these days because spreadsheet, data base and word processing programs already serve most these needs. Many programs exchange data with other programs.

WHAT IS IT GOOD FOR?

Three things: Business, activism and personal enrichment. The business uses are many, either in support or mission-critical roles (like developing software). Activism, individual or organized, is a high growth use. Computers are persuasive, relentless and make excellent work multipliers. Personal enrichment through computers is an excellent use. You need not justify it to anyone but you. Its OK to engage in "recreational computing". Its OK to expand your mind. Many who start computing as a hobby find themselves using it in business soon after. Its even OK to play PacMan.

WHAT CAN IT DO?

Just about anything you can think of. Many successful systems serve just one obvious, high profile application. My personal vision of computerizing is a six-step process. While maximum return comes from integrating all six, you can take them in order, integrating the latest step with the others. Satisfying results exist in each step. I include examples from my personal experience.

Collecting

I consider this only the first stage of computer use, but it is good enough for many tasks. A computer tends to make you find, gather, filter, classify and evaluate information. It begs completeness, uniformity and discipline. After you have collected the data, you can sort it, search it, select it, analyze it and print it. Some examples: One business had double paid sales and use taxes but it was too much trouble to manually sort the data out. Numbers for all the transactions were put in the computer and sorted by item number and state. All duplicates ended up next to each other. Tax returns were filed and $90,000 hard cash was recovered. Another business needed to inform 30,000 customers of new customer numbers. The computer printed the info on post cards in zip code order (to lower postage). The job finished in four hours of printing. With today's printers, we could have pre-barcoded the zip and saved even more postage.

Analyzing

Step two is determining what the data means. Example: An arcade company discovered they had run the business poorly for 10 years. The computer found correlations (relationships between variables) that let them predict the lifetime income of any game within 10% and when to sell it. Analysis made a $4 million annual difference.

Visualizing

Step three is to make the analysis obvious. Humans are visually oriented. Pictures persuade. Conclusions are obvious in graphs and charts that are hidden in straight text. Example: The game company executives argued with our findings until we graphically presented our information. We found additional valuable info, too.

Designing

Step four is not applicable to every situation, but think for a minute. One diabetes patient "designed" his diet to control blood sugar levels, reducing the medication and its side effects. CAD (Computer Aided Design) programs that produce blueprints are better known. Programs specific to the renewable energy industry specify PV systems and verify passive solar designs.

Optimizing

Step five leverages the understanding gained in previous steps. Example: A carpenter needed expensive window trim for a house. He typed all the different lengths into a computer and sorted them into standard lengths available. Result - no waste.

An under rated form of optimization is Project Management (PM). More fallout from the space program, PM optimizes resources, including time and talent. Activities of hundreds of people performing thousands of tasks can be effectively coordinated. Example: The original project plans of one company had a specific deadline. The task types, durations, dependencies, available people, vacations, etc. were run through the project scheduler. The computer projected a slip of 7 years past the deadline. Result: some drastic organizational changes were made.

Producing

Step six is for computers most closely tied to your products and services. These include desk top publishing, commercial art, technical drawing and program development. These new opportunities were made possible by computers only recently. You

are looking at a fine example of Desk Top Publishing (DTP) as you read Home Power Magazine. The skill, experience and hard work by the HP Staff combined with computers make it practical. DTP can do all types of documents: menus, greeting cards, flyers, posters, signs, newsletters, proposals, reports, business forms, pamphlets, books, manuals, and catalogs.

Commercial art is often created directly on small computers. The AirCastle ad in this issue was created completely electronically. Yellow Pages publishers do all the ads this way. Technical drawings include architectural blueprints, mechanical drawings, printed circuit board artwork and assembly drawings.

Program development is not new, but the applications could be. Write me if you need special software or could create some. I'll act as a clearing house to match the applications.

Communicating

This works well with all 6 steps. Properly configured, you have electronic mail capabilities. You type messages which are stored until the recipient logs in. Western Union lets you send telegrams, overnight mail, etc. anywhere in the world.

Another use is accessing Computer Bulletin Board Services (CBBS). These also have electronic mail, but only between CBBS users. All it takes to set one up is a computer, phone line(s), phone connections (modems) and a System Operator (SYSOP). Call or write if you know of CBBSs dealing with alternative energy or you wish to start one. I'll publish the info.

HOW DO YOU POWER IT?

The obvious strategy using standard parts and plugging everything into an inverter has several problems. It's not as easy as it looks.

Inverters

Modern computer components use power supplies that convert the 120 vac produced by the inverter back into low voltage DC . This wastes power in needless conversion of low voltage DC into 120 vac and then back to low voltage DC. Since most computer equipment operates on low voltage DC anyway, using an inverter adds not only cost but inefficiency to the system.

Consumption

Mass marketed systems are designed for low purchase price, not low power consumption. Laser printers draw about 800 watts, far too much for most renewable energy systems. The computer itself may draw several hundred watts, the display monitor about 150 watts. To make computers practical in a power limited environment, the components must be carefully chosen for low consumption. It is possible to pick parts that use from 5 to 50 times less power with comparable performance.

Costs

You have heard it before, "It cost a little more, but it's a better deal". This time, it really is true. With renewable energy, you buy the stuff that both makes and uses the power. Paying more up front for lower power consumption means paying less up front for power production. Solar power cost about $10 per watt, including panels, batteries, inverter, racks, wiring, etc. Of course, "your mileage may vary", so calculate your up front energy cost for use in your decision making process. Many people had no need for an inverter until they purchased a computer. With low voltage computers, you can save the $600-$1,500 cost of an inverter and a considerable amount for PVs, batteries, etc.

HOW DO YOU START?

Start by backing up a little. Think of the software you need first, then the hardware to run it. It's a variation on "form follows function". Start your research with computer magazines. Ask people for their recommendations, but be cynical: folklore and personal preference are often presented as facts. Ask to try the computers and programs of interest.

How Do You Choose Software?

It can be as simple as picking the same type as your friends or employer- be compatible. Or, if your requirements are moderate, consider shareware or public domain software for its variety and low cost. Computer bulletin boards have free programs. For mainstream applications, shrink-wrapped software has sophistication, size and feature richness.

Now For The Hardware

Two approaches now exist. Laptops are already low in power consumption and easy to convert. Because they are compact and light weight, they also have high prices, no or limited buss expansion, slower computing speed and tight storage capacity.

A better method involves careful choosing of the lowest power consumption parts available. These parts may be modified to use still less power. Custom designed, high efficiency power supplies complete the package. A usable IBM PC compatible system with floppy disk, monitor and printer is possible for under $700. If ultra-low power consumption is desired, higher priced components are used in systems drawing under 6 watts.

WRAPPING UP

High performance computing is now practical in power limited situations. Since it enables more kinds of home based business and optimizes their effectiveness, it may even be essential.

ACCESS

John C. Osborne, AirCastle Enterprises, 15926 Northville Road, Plymouth, MI 48170 • 313-348-7135.

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The SolarWind Solar Home

Bill Sechler

What is the SolarWind Home? How does it work? Why the six-sided, hexagonal shape?

Bees Love It

Hexagons are an inherently strong stable shape. Bees have been using it for a VERY long time. Hexagons use 16% (1/6) less exterior wall than a square house for the same number of square feet. That's 1/6th less wall to build and lose heat. The wide, 120° angles provide a comfortable, less confining, useable living area. Hexagons are more efficient solar collectors. A square exposes 1/4 of its space to the sun while a hexagon exposes 1/3.

Thermal Mass

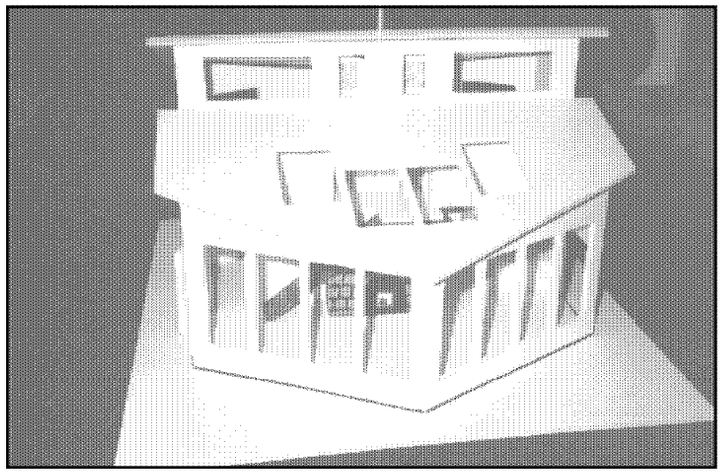
A unique feature is the large, solid fireplace/chimney. It's nine feet square by three feet thick and weighs 50,000 pounds. It's mostly full of concrete and is technically called a "thermal mass". But it's simpler and more direct to call it "The Rock" since that's what it is. What The Rock does is collect and hold heat either from the sun and/or from the built-in woodstove. In the lower center of the The Rock is the fireplace. This is a steel lined arc, with duct and chimney openings cast into the concrete. Fitted into this arch is a highly efficient wood burning stove which draws its air from outside the house. The wood stove heats water and The Rock itself. The arch and associated ducts also heat and circulate air throughout the house.

The outer walls and roof of the building form a heat tent. This is because the heavily insulated walls and roof hold and reflect heat back into the building. Some heat escapes but much more is trapped. Since The Rock weighs 50,000 pounds and the combined total of all the other materials within the heat tent equals 5,000 pounds, the temperature of the heat tent (house) is going to be very close to Rock temperature. The Rock's mass totally dominates the space. Another benefit of the hexagonal shape is that nowhere in the house can a person get further than about 16 feet from the Rock. This gives gentle, radiant heat throughout the building. If the radiant heat is not enough when the outside temperature drops, you open the air ducts and forced, warm air, powered by the heat in the stove arch (not fans) will quickly heat the house.

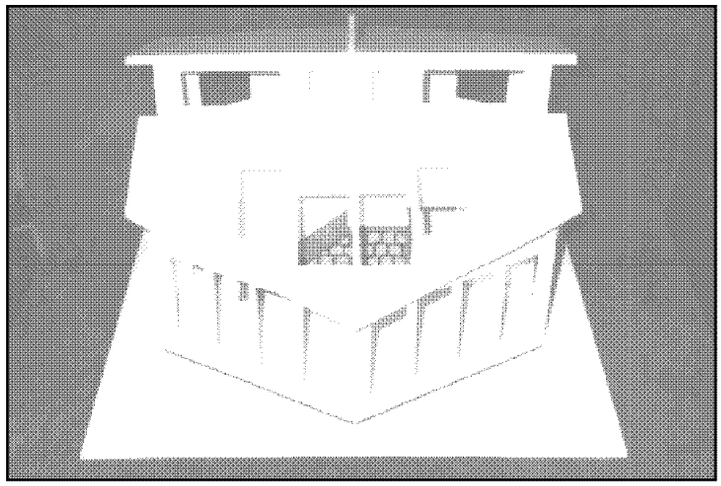
Provision to let heat out of the house, when desired, is also designed into the structure. The upper landing and bedroom walls form a large, 13 foot high flue. At the top of this flue are two remote opening windows. The windows are 20 feet up from the first floor. When opened, these windows and flue will draft (suck) just like a chimney, which is a type of flue. This exhaust flue is heat powered so that the hotter the house, the greater the draft. Any doors or windows opened in the house will then experience an immediate intake of fresh, outside air in direct proportion to the amount of excess in the house.

These features are built into the basic structure of the house. They don't break or wear out. They don't make any noise. They don't take any outside power.

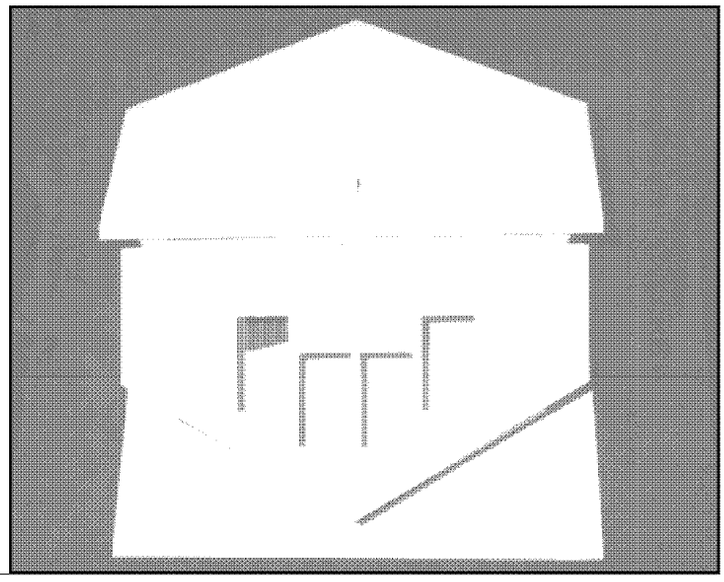
The SolarWind Solar Home contains a total of about 1400 square feet. It has three large bedrooms (downstairs is 180 square feet, two upstairs are 150 square feet each), two full baths, high ceilings in the upper bedrooms (sloping from 7+ to 13 feet) and the living

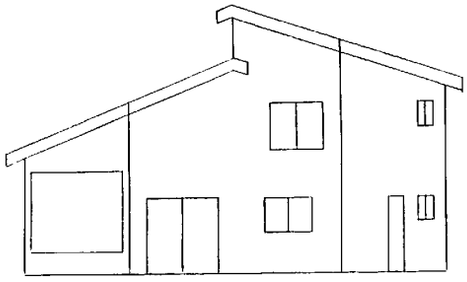


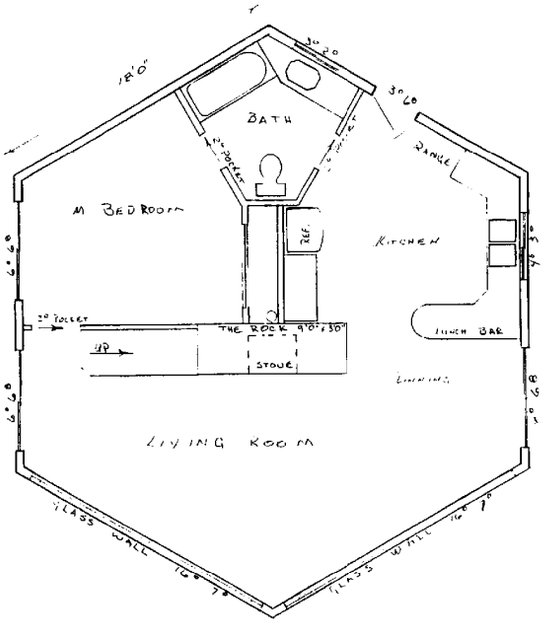
Above: Winter View. Photo by Bill Suchler.

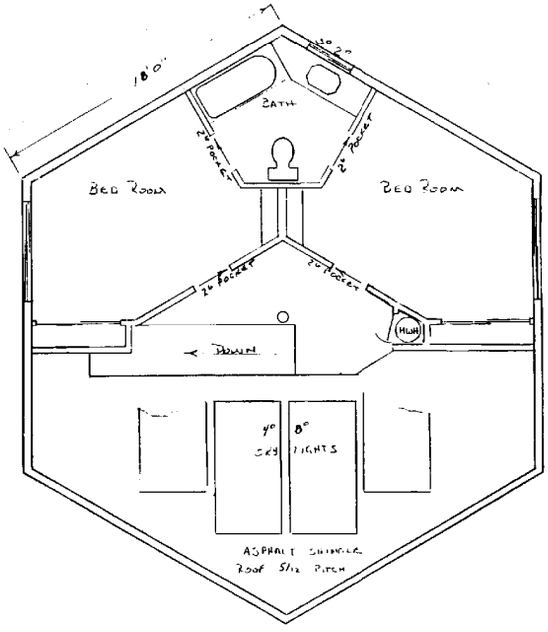


Above: Spring/FallView. Below: Summer View.
Photos by Bill Suchler.









room (sloping from 11 to 17 feet). The living room is 30 feet long and 15 feet wide to the point of the 36 foot window-wall. There are 4 large skylights for the mid-season (spring & fall) light and heating. The south facing upper bedroom windows are placed so that they will admit direct sunlight in winter but not in summer. There is no space given away for hallways in this design.

This home is designed to be primarily solar powered for heating, hot water and electricity with propane to help out with the cooking. I estimate that it will need about two cords of firewood to supplement the solar heating during extended cloudy weather. The owner could elect to hook up to the power company. Everything would still work the same. It just isn't necessary.

Access

Bill Sechler, SolarWind Energy Systems, POB 780, Bandon, OR 97411 • 503-347-3316

TO CONNECT OR NOT CONNECT -- THAT IS THE QUESTION

John Wiles

Photovoltaic (PV) modules have something in common with batteries -- they both can supply power even at times when it is not wanted. From a safety point of view, the National Electric Code requires that we be able to turn off or disconnect these sources of power at certain times to service or remove equipment in the PV system. As PV users, we must not only be aware of safety, but also of performance, cost in the design, & selection of disconnect components for our alternate energy systems.

Safety

The code requires that as a minimum we have a disconnect on both the PV array and the battery and any other source of power in the system such as a backup generator, hydro plant, wind machine or other battery charger. The disconnects shall be marked and grouped together. In a multiple source system, no more than six motions of the hand can be used to disconnect all sources of power. This last requirement may mean that multipole disconnects must be used. A disconnect can be, depending on location, either a switch, bolted connection, or terminal strip. In a grounded system, the positive conductor disconnects should be appropriately rated dc switches. The grounded conductor (normally negative) should never be broken with a switch and should have disconnects made with bolted connections. In floated PV systems which are not grounded (less than 50 volts open circuit array voltage), both conductors to the PV array and the battery or other source must be disconnected with a two-pole switch.

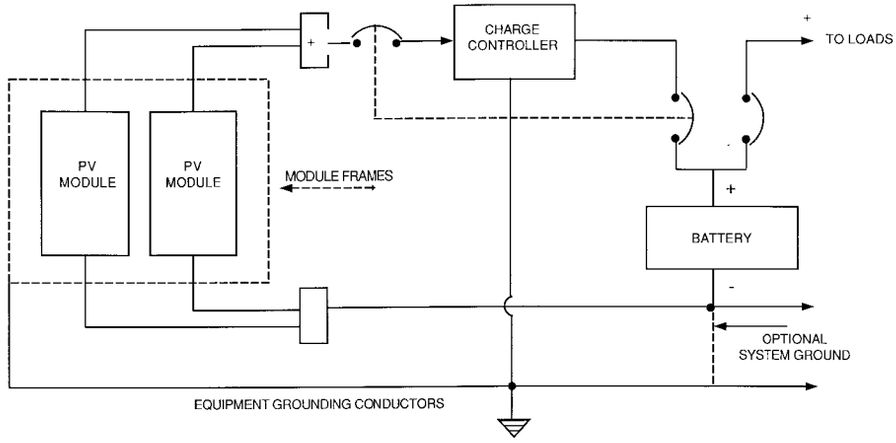


FIGURE 1 SMALL SYSTEM

Performance

When disconnecting the battery, we need to make sure the PV array does not remain connected to the load because without the regulating feature of the battery, the high open circuit PV voltage might damage various electronic devices like fluorescent lamps and computers. Some charge controllers are sensitive to the connect and disconnect sequence and some wind machines need constant loads or they will be damaged. These requirements dictate that our switches must be placed very carefully.

Figure 1 shows a possible disconnect system for a small to medium size grounded PV system. Ampacity of the conductors and rating of the overcurrent devices will be determined by the number of modules and the load. A two-pole switch is used to disconnect both the input and output of the charge controller at the same time and two separate conductors are run to the battery so the load cannot be connected directly to the PV array.

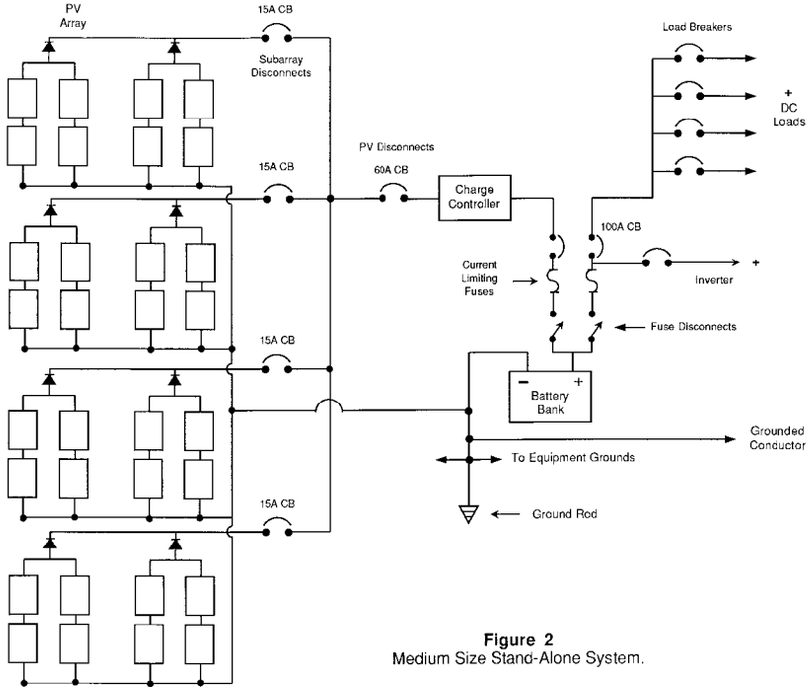


Figure 2
Medium Size Stand-Alone System.

Low Resistance Connections

Care must be given to use good, low-resistance connections, terminal strips and connectors as well as the highest quality switches, circuit breakers, and fuse holders. When we combine the devices required for overcurrent protection, short-circuit protection and disconnects we can come up with a number of connections between our power sources and the loads. These connections, if not properly made, can create unwanted voltage drops and lost power even to the extent that the equipment will not work. Heavy duty copper terminals and connectors must be used especially in inverter circuits. Consideration should be given to combining the overcurrent function with the disconnect by using a circuit breaker instead of a fuse and switch. The number of contacts and connections will be greatly reduced and so will the

potential for excess voltage drops and power loss. With Square D QO residential breakers UL listed for 48 volts and up to 70 amps, there seems little reason to stay with separate fuses and switches which will cost more and possibly create reliability problems.

A Bigger Picture

Figure 2 shows the disconnects, overcurrent protection, and short-circuit protection for a medium size PV system. The rating of the overcurrent devices is shown as an example only and must be based on 125% of the PV short-circuit current for each separate location. Fuses and circuit breakers in the battery circuits are of course sized for the loads they must handle--see Code Corner in HP 16 & 17.

The 15 amp circuit breakers provide overcurrent protection for the smaller wires used to interconnect the modules and provides subarray disconnect capability. The conductors between these breakers and the 60 amp breaker must be sized to carry at least 60 amps or the 60 amp breaker will be unable to provide the proper protection. In this system, it is assumed that large, low-resistance conductors are being used to minimize the voltage drop and provide high levels of power to the inverter. These large conductors necessitate the use of the current limiting fuses to keep short-circuit currents under control. In the next Code Corner we will cover dc and ac distribution systems.

Access

John Wiles, SWRES, PO Box 30001/Dept 3SOL, Las Cruces, NM 88003 • 505-646-1846.

Things that Work!

The Sun Oven™

Testing conducted by Karen Perez

Cooking with the sun works! There's an inner satisfaction eating a meal grown and cooked by the sun. It just plain tastes better, too. There are many designs, all work , some better than others. The Sun Oven is long lasting and has several features that make it very easy to use.

Packaging and Documentation

The Sun Oven is well packaged. The oven is packed with enough sheet foam to make a really nice pillow, no nasty peanuts. The one used in this test arrived safely after traveling from MN to AZ to CA to OR. There's not much in the way of documentation, but not much is needed. The docs do include care, setup, utensils, and a few recipes & solar cooking hints. A larger recipe booklet is promised in the near future.

The Sun Oven

The Sun Oven is a well constructed, first class unit. The body of the cooker is fiberglass and is insulated by dead air. The inside (usable interior dimensions: 14"W. x 12"H. x 15" D.) is painted with black non-toxic paint. The door is thermal pane, tempered glass that's very easy to open and close and has a whale of a good seal. The reflectors are very shiny (spectral-quality) aluminum, hinged for easy transport and keeping food warm. The oven also has an adjustable leg for easy sun focusing. A really nifty gimbaled shelf helps keep pots level. There's even a carrying handle and a strap to secure the reflectors. Suave!

Sun Oven Performance

In the last few weeks I've cooked everything from stews to bread. So far, everything has cooked wonderfully. I love baked potatoes, 7 medium ones were cooked to perfection in 1 hour 15 minutes. WOW! (Included are charts with data from several days of entirely edible experimentation.) The docs say to reduce water in recipes by 1/3. They aren't kidding. One cup of water per cup of brown rice is plenty. My only problem with the oven was the interior size, mainly because I wanted to cook more than one dish at a time. I overcame this by stacking pots within the oven. A few days ago I wanted to cook rice, chicken and bread. A cast iron dutch oven held the chicken and rice. I inverted the lid and used it as a platform to bake the bread. It worked great.

Conclusions

I love it!! In the last three weeks of use the Sun Oven has noticeably reduced our propane consumption. A standard snickered question is "What do you do when there's no sun?" My answer is, "Use SOME of the propane I saved."

The Sun Oven really fits our routine, too. In the morning, when I'm energetic, I put dinner in the oven, face it south and forget it. In the evening, when I'm beat from working on Home Power all day, dinner is hot and ready.

Sun Oven is well-made and should last a long time. I think it is worth its price because it works, is portable and durable. If you want to try solar cooking, but don't have the cash for a pro built cooker, try making your own. There's a book reviewed in this issue (pg. 52) that will tell you how.

The Sun Oven cooking up a load of pinto beans, part of an entirely solar powered Mexican dinner that also included spanish rice.

Access

Contact Sunlight Energy Corp., 4411 W. Echo Lane, Glendale, AZ 85302 • 602-934-6492 or most RE dealers. Retail price is $179.

I'm happy to discuss solar cooking. Call or write: Karen Perez, C/O Home Power, POB 130, Hornbrook, CA 96044 • 916-475-3179.

SUN OVEN TEST DATA

RICE

Time	Oven Temp. °F.	Outside Temp. °F.	Comments
12:07 PM	300	71	Oven empty
12:08 PM	250	71	Inserted 4 cups water
12:32 PM	250	73	Added 2 cups rice to pot
12:48 PM	225	75	
1:18 PM	250	76	
2:07 PM	225	77	Rice cooked and done

COFFEE CAKE

Time	Oven Temp. °F.	Outside Temp. °F.	Comments
9:58 AM	250	72	Coffee cake inserted
10:30 AM	225	73	Cake rising nicely
10:45 AM	225	72	
11:01 AM	225	72	Browning
11:39 AM	300	74	Cake done

BAKED POTATOES

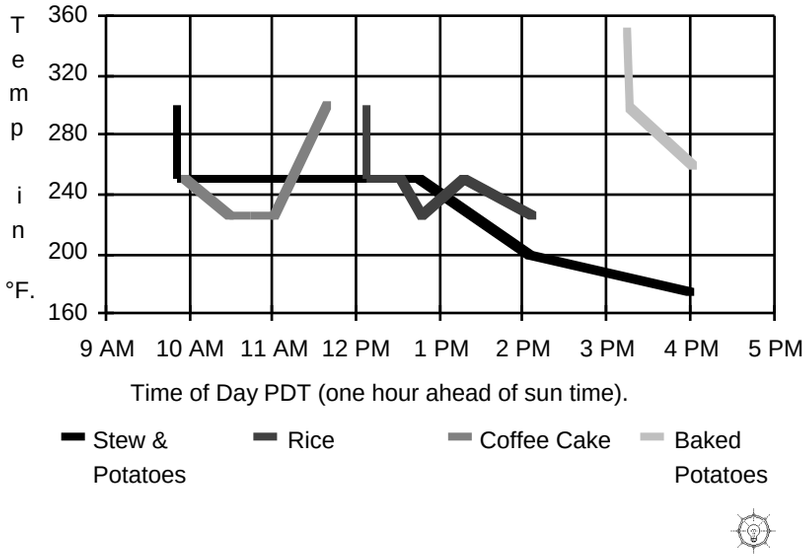
Time	Oven Temp. °F.	Outside Temp. °F.	Comments
3:15 PM	350	79	Oven Empty
3:16 PM	298	79	Inserted 7 med. potatoes
4:02 PM	260	80	Potatoes Done

BEEF STEW & POTATOES

Time	Oven Temp. °F.	Outside Temp. °F.	Comments
9:51 AM	300	72	Oven Empty
9:52 AM	250	72	Inserted 4 quarts stew
11:13 AM	250	76	
12:45 PM	250	81	Added dish with potatoes
2:05 PM	200	81	
4:00 PM	175	77	Stew & Potatoes done

Note: All times PDT (one hour ahead of sun time).

Sun Oven Performance in four test runs.



Energy Conversion

Chuck Carpenter, W5USJ

Conversion of energy forms is often needed when you install off-the-grid power systems. You may want to make cost justifications using alternate systems. Or, you may want to know what's going on in an existing system. Regardless of the reason, make conversions using known standards.

Energy, Force, Work and Power

These terms establish the basis for their electrical equivalents. Energy is the capacity to do work. Force is a factor of work and, to do work, has to be applied over a distance. Work is done when energy is used and is calculated as the product of the magnitude of a force and the distance traveled in overcoming a resistance. Power is the rate of doing work. Our applications of these physical basics are primarily to generate electricity.

Electrical Work

Electrical force (called electromotive force or EMF) exists between the terminals of a battery or generator. When there is no load connected to the terminals, no current flows and no work is done. By connecting a load (e.g., lamps, motors, electrical appliances), across the terminals, the electrical force is able to overcome the resistance of the wires connected to the load. Current will flow, and electrical work is done. In a light the work is in the form of heat & light. Work by the motor is done by turning its shaft and the load connected to the shaft.

Electrical Power

Power is the rate that work is done, and is independent of the total amount of work accomplished. Using the " / " to indicate division, mechanical power is expressed as:

Power = work / time or P=W / T

For electrical power, then, the expression would be:

Electrical power = electrical work / time

The unit of electrical power is the watt. Using " x " to indicate multiplication the expression is:

Watts = volts x amperes

Using conventional symbols, electrical power (P) equals the electrical pressure in volts (E) times current in amperes (I), and is expressed as:

P = E x I

For example, with an EMF of 110 volts (E), and a current flow of 10 amperes (I), then: P = 110 x 10 = 1,100 watts

Electrical Horsepower

Motors are generally rated in horsepower or fractional horsepower. The relationship of mechanical horsepower to electrical horsepower shows that one foot-pound of force is equal to 1.356 watts. Also, it is known that 550 foot-pounds per second are equivalent to 1 mechanical horsepower. The equivalent rate of electrical power would be:

1 electrical horsepower = 550 x 1.356 = 746 Watts

A motor that has a rating of 220 volts and 20 amps, then you can determine its horsepower (H.P.) by the following relationships.

H.P.= watts / 746 = volts x amperes / 746 = (220 x 20) / 746 = 5.898

Kilowatt Hours

A value of 1,000 is represented by the letter "K" (for kilo). If you maintain a power level of 1,000 watts for one hour, your load has used 1 kilowatt hour (KWH). It is also equal to 500 watts used for 2 hours, or 2,000 watts used for one-half hour. The value of 1,100 watts from the previous example is equal to 1.1 KWH.

British Thermal Units

Heating appliances use ratings in British Thermal Units or BTUs. A BTU is the quantity of heat needed to raise the temperature of 1 pound of water one degree Fahrenheit. Don't confuse quantity with intensity. A cup of water at 150 deg. F will contain less heat that a pail-full at 70 deg. F. The BTU is also equal to 778 foot-pounds, 1055 watt seconds, and 0.000293 kilowatt hours.

Fuel Conversion

How would you convert from one form of energy to another? More specifically, what do you do to convert from the various types of fuel to other energy uses. Examples would be (1) gasoline, natural gas and propane powered generators to KWHs, (2) electricity to BTUs, and (3) natural gas or propane to BTUs. The various conversions you might use depend on your application.

Gasoline is not normally used as a fuel in the sense that natural gas and propane are. Therefore, there is not a direct multiplier for conversion. However, most gasoline generators indicate average fuel consumption related to load and time. Check the specifications of a particular generator for these values. For example, a 5 KW generator may use 1.5 gallons per hour at full load. That's 5 KWH at the cost of one and a half gallons of gas. Using previous information you can convert 5 KWH to horsepower, or to BTUs from the following information.

Natural gas is generally converted to BTUs at 1,000 BTUs per cubic foot. If a generator uses 100 cubic feet per hour to generate 5 KWH, the cost of 1 KWH is equal to the cost of 20 cubic feet of gas. Note that some sources use the value of 750 BTUs per cubic foot.

Propane converts to BTUs at 2,500 BTUs per cubic foot. The calculations would be the same as natural gas. However, the fuel use rate will be less because of the higher conversion factor. You don't get an improvement of 2.5 times, however. The efficiencies are different, and the cost of propane is higher than natural gas.

Electricity converts to BTUs at 3413 per kilowatt hour. In the example above, 5 KWH times 3413 is equal to 17,065 BTUs. If the cost of electricity is 0.08 per KWH, then the cost of 5 KWH is $0.40 and you can relate this to the cost of energy in BTUs.

Fuel Oil conversion to BTUs is another useful quantity. The standard unit is 100,000 BTUs per gallon.

Cost Estimating

Don't forget to include all of the factors involved in your cost estimates. Fuel used in a combustion engine is more efficient than in a furnace where up to 30% of the heat goes up the chimney. Electricity to heat conversion is considered to be 100%. And, you have all the costs of facilities, installation, maintenance, supplies, and replacement to consider too.

ACCESS

Chuck Carpenter, 3714 Bishop Hill, Carrollton, TX 75007 • 214-306-8140.

Things that Work!

Sangean ATS-803A AM/FM/SW Radio Receiver

Richard Perez

When we moved to the country we left more than commercial electricity and good roads behind. We also left communications behind. In many rural locations reception of radio and TV signals is marginal. This is especially true in mountainous areas. Over the years we've used a variety of radio receivers to bring the world into our little remote home. This Sangean receiver is the best of the lot.

The Sangean Receiver

This radio receiver will listen just about anywhere. The frequencies covered are anything between 150 and 29999 kHz. (and that's a lot of space; everything from below AM broadcast, all shortwave bands, and continuously up through CB radio and above), and FM stereo. It will also scan for active frequencies on any of its bands.

The Sangean is a digital direct entry system. You enter the frequency you want on a digital key pad with extensive feedback available on the LCD display. Manual tuning is also happening via a dial on the side of the radio. The unit has nine memories to store frequencies. It has a built-in clock which can either turn the radio on or off at preset times. The LCD has a switch selectable back light for night-time use. Physically the radio is small (12"W x 6.25"H x 2.5"D) and weighs in at 5 pounds with batteries.

The radio contains two AA batteries for the clock/memories and six C cells to provide 9 VDC power for the receiver. I used the Sangean on a small 12 VDC to 9 VDC converter I built, on C batteries, and through the supplied 120 vac to 9 VDC power supply (a wall cube). All worked fine. I was especially impressed by the radio's ability to ignore local noise when powered by an inverter via the wall cube. I ran the Sangean (via wall cube) on the Heliotrope PSTT, Trace 2012, PowerStar 200, and the Statpower 100 inverters; all with only very minimal receiver noise from the inverter. Power consumption is low- on the order of three watts.

Sangean ATS-803A Performance

This is a hot receiver. It succeeded in pulling in weak stations with only its built-in telescoping antenna. When I hooked it up to my 300 meter longwire (via the supplied adapter), the receiver got stations that I never heard on any receiver before. It is the most sensitive general coverage, shortwave receiver I have ever used. The keyboard entry of frequency is really slick, just punch in the numbers. I had no trouble finding my favorite BBC station for the news. And if you don't know the frequency, the Sangean will scan the airwaves looking for signals. Since it uses Phase-Lock-Loop (PLL) circuitry to tune frequency, it is very stable. I found it stable enough to listen to the Home Power single-side band net on the 40 meter ham band without constant retuning of the BFO. This is not possible with most general coverage shortwave receivers.

And the icing on the cake is that the Sangean also receives FM stereo. The ATS-803A comes with a stereo headset. When the unit was plugged into its optional amplified stereo speakers, it out performed my house system for the clarity of the FM music and for sensitivity on distant (and therefore weak) FM stations.

The documentation provided with the Sangean is extensive and highly functional. I had no trouble figuring out how to work it. Also provided with the radio was a handbook on shortwave listening giving frequencies and times of international shortwave broadcasts.

Conclusions

The Sangean ATS-803A is an exceptionally stable & sensitive general coverage receiver. Its direct keyboard entry and memories make it easy to use. Its small size, low power consumption and ability to operate from a variety of power sources make it a natural for home power systems. At $199.95, it an't cheap, but then it outperforms receivers I've had that cost over twice that much.

Access

The Sangean ATS-803A is available from C. Crane and Co., 147 Watson Lane, Fortuna, CA 95540 • 707-725-5940.

Things that Work!

The SunAmp Power Co.'s PV Regulator

Richard Perez

This regulator is simple to use, reliable, and inexpensive. The SunAmp Model PBRS regulator is 100% solid state (no relays), using a MOSFET transistor as a switch. The regulator is temperature compensated and available in just about any voltage limit. It is ideal for small photovoltaic systems.

The SunAmp PBRS Regulator

This regulator is a different type than the series PV regulators we have discussed before. This regulator is actually a shunt type that shorts out the PV array when the battery voltage reaches the factory set limit. The FET switch is on the array side of a blocking diode, so current can only travel in one direction -towards the battery. When the FET shorts out the array, it does so on the array side of the diode and the battery is not shorted. This novel approach eliminates the need of a shunt load and results in a very cool running regulator.

Test System

I installed the PBRS12-4LA regulator in my small auxiliary PV system. This system uses a single ARCO M75 PV module to refill a 110 Ampere-hour RV deep cycle, lead-acid, battery. I use this system to power up instrument and regulator tests. When I'm not actively using it, it tends to overcharge. A perfect place for the SunAmp regulator, I mounted it next to the batteries. There are four wires to hook up- plus & minus from the array, and plus & minus to the battery.

The PBRS12-4LA is rated to handle 4 Amperes of current and has a voltage switch point of 14.5 VDC. The SunAmp factory can set the regulator up for whatever voltage you require- from 13.5 VDC for cranky lead-acids to over 16 VDC for nicads. They make models that will handle up to 18 Amps and models for 24 and 48 Volt systems.

Regulator Performance

It works well, indeed. There was virtually no noticeable heat build up when the regulator was operating. Voltage switch point was within 0.06 Volts of where SunAmp said it would be. There is an internal temperature sensor that raises the voltage switch point when the regulator (and the batteries) get cold. The unit is equipped with a TransZorb™ surge protector to guard against lightning.

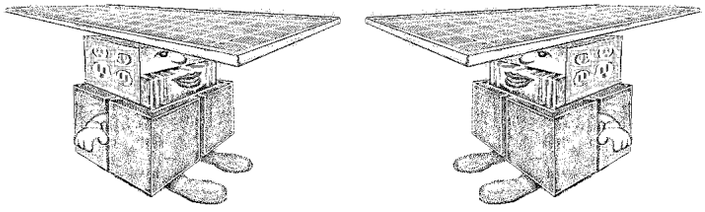
Conclusions

The SunAmp Model PBRS are very effective and inexpensive in small PV systems using less than eight modules. They are temperature compensated, available at a variety of voltage switch points, and carry a five year warranty. The 4 Amp model I tested costs $46, which is inexpensive considering its features. Other models cost between $45 and $113 depending on Amperage and Voltage.

Access

SunAmp Power Co., 8502 East Cactus Wren Road, Scottsdale, AZ 85253 • 602-951-0699.

System Shorties



System Shorties are brief notes from readers about their home power systems. To join the party, send material similar in spirit to what you see here. We will edit for clarity and conciseness.

Bergey Wind Power Answers

In the System Shorties section of the last issue of Home Power (#18) David Mann of Anguilla, B.W.I. gave us a "buttkick" for selling him a used piece of equipment without his knowledge. In fact, we supplied him with a brand new, but defective controller for his BWC 1000 wind turbine. When the problem was discovered we first repaired the units' circuit board and when that failed to cure his problem we replaced the entire controller. The day after HP#18 arrived I contacted David to find out why he thought we had sold him a used controller and found out that our dealer was responsible for the false information. David reports that he is satisfied with his Bergey equipment and I think it's important that your readers understand that we didn't sell them a false bill of goods. I'll also point out that Tilt-up towers are available that eliminate the need for owners to climb the wind turbine tower.

Sincerely, Michael L.S. Bergey, Pres. Bergey Wind Power, Norman, OK

PV Powered in Vermont

I find your magazine very informative. Ten years ago we built our home in Vermont and the utility company wanted $13,000 to install electricity, which I thought was exorbitant.

I had my saltbox house, 24' x 30' , wired with 10 gauge wire and powered with two tractor batteries and charged by 4 Arco photovoltaic panels. I have since added two more Arco PV panels and replaced the tractor batteries with two deep cycle batteries. This has given me excellent service and the original cost was approximately $2,500. I contrast this with the elaborate system that Paul Palumbo writes about, in the #17 issue, costing $61,000.

I have always been interested in solar power and natural gas generator. When I worked at the University of Malawi, the head of my department had made a natural gas generator which provided gas for cooking the food for the workers in the agricultural section. Hence, I read with interest the article "Hands On" Solar Power in the #17 issue.

In the same issue, Paul Cunningham's Hydro Systems Using LCBs was good to read as I thought it might be of value to me. I have a gravity flow water supply with a head of 25 feet. In the winter time I have to keep the water running so that the water in the pipe coming to the house does not freeze, as it is buried only a few inches underground in our rocky terrain. Since I have to keep the water running it might be useful to use this water power to turn an electric generator and charge my batteries, especially in the winter when we might have several weeks of cloudy weather. Hence my interest. Keep up the good work with your magazine.

Sincerely, John Careccio, Mansfield, VT

One PV Panel can be Plenty

Here's my subscription $. I've had a one-panel PV system for a year now and it's working famously. Maybe it's because I've developed a lean energy consumption diet from 10 years of candle power and kerosene lamps, or possibly it's due to living in the sunbelt of the Mt. Shasta region. But I'm able to get by quite well with a single panel. Because of this discovery I'm put off by info catalogs saying a one panel "starter" system is only good to "run one or two 12V lights and an AC/DC black and white TV or cassette player."

Hah! My Arco 75, along with two deep cycle batteries, supply all the light my friends and I need in two shelters, plus a 10-inch color TV and VCR (with juice for double features in summer). All this without a sun tracker either. Panels are great for teaching us to conserve power and reduce America's voracious energy consumption habits, so when catalogs promoting panels fall into the same more-is-better trap they not only cater to to the energy junkie in all of us, but unwittingly discourage people who can perhaps only afford one panel from making the leap. I'm here to say that if one leans his energy diet down to a comfortable minimum, a one panel system can be a veritable horn of plenty.

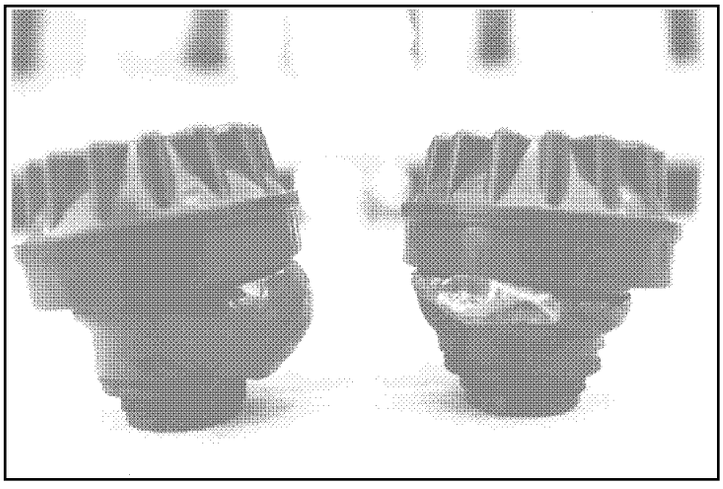
Stuart Ward, Montague, CA

TECH NOTES

Bob-O Schultze-KG6MM

Everybody knows that you can kill a set of batteries by letting the water level get too low for too long, but overfilling the batteries with water can be just as harmful-and maybe even dangerous!

On a recent service call, I came upon a strange thing. One set of a group of four Trojan L-16W batteries had literally blown themselves up like a balloon! Not only that , two of the six Hydrocaps™ on the set had experienced a similar blow-out and meltdown. Clearly we had a major heat buildup here, but why? The system had been performing without any problems for years.



An investigation of the surviving set of L-16s told the tale. The other set was nearly a quart of fluid overfilled. Apparently, a guest to this remote homesite took to heart the homeowner's admonition about not letting the battery water get low and FILLED THEM UP-PLUMB TO THE TOP! He then proceeded to charge the pack using the 50 Amp charger in his inverter. At some point in the charging process, the liquid heated up and expanded, saturating the platinum catalyst screen in the Hydrocaps™, and making a hydraulic seal which allowed the hydrogen gas to build up to what must have been substantial pressure and heat. These forces, in turn, caused an internal short in one of the Trojans-which built up more heat- and destroyed the batteries.

The question arises as to whether or not this gas build-up would have occurred had the cells not been equipped with Hydrocaps. I believe that the sheer volume of heat-expanded electrolyte generated by the 50 Amp charge rate would have caused a problem even if the batteries were fitted with the original caps.

To most Home Power folks, this incident must seem like a pretty far-fetched and remote possibility. Think again. Many families have someone housesit for them while vacationing or visiting far from home. Make sure that you take some extra time to educate your sitter to the realities of Home Power living. The piece of mind alone is worth it.

Access
Bob-O Schultze, Electron Connection Ltd. POB 442, Medford, OR 97520 • 916-475-3401.

H A P P E N I N G S

NE Sustainable Energy Assoc.

November 11,1990 - 2nd annual SOLAR ELECTRIC VEHICLE SYMPOSIUM, sponsored by the American Tour de Sol of the Northeast Sustainable Energy Assoc., Manchester, NH Contact: NESEA •413-774-6051

March 1-3, 1991 - 8th annual ADVANCED RESIDENTIAL CONSTRUCTION CONFERENCE, sponsored by the Quality Building Council of the NESEA, Springfield, MA. Contact: NESEA • 413-774-6051

May 21-25, 1991 - 3rd annual AMERICAN TOUR de SOL, The solar & electric vehicle championship, sponsored by NESEA, Albany, NY to Boston, MA. Contact: NESEA • 413-774-6051

SunAmp Seminars

SunAmp Power Co. will hold 2 day PV seminars on Nov. 9 &10, 1990 and Jan.18 & 19, 1991. These seminars are designed for everyone from professionals to do-it-your-selfers. Topics will include introduction to PV hardware, demonstrations of systems, instrumentation, information access, system design and marketing. Cost of each seminar is $145.00 ($100. for each additional person in the same party) and includes two lunches, refreshments, syllabus & classroom materials. For more information contact Steve at SunAmp Power Co., POB 6346, Scottsdale, AZ 85261-6346 • 602-951-0699 or TOLL FREE 1-800-MR SOLAR.

Help Wanted for Solar Train

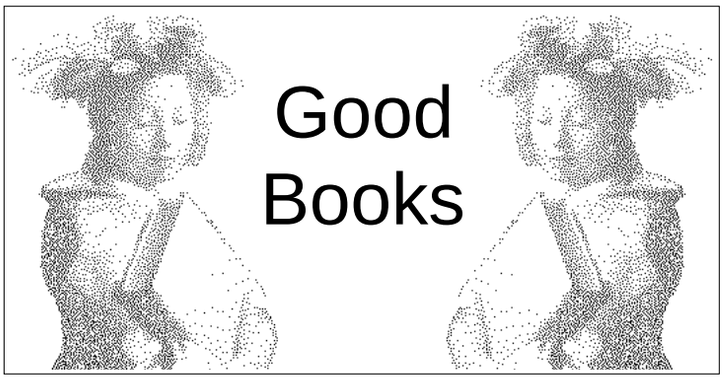
A couple of timely occurrences in Willits have brought together some natural energy. During the Solar Energy Exposition & Rally (SEER) in August the Mendocino County Railway Society (MCRS) sponsored a model train powered by solar charged batteries. A week after SEER the Public Utilities Commission held a public workshop to discuss ways of increasing California Western Rail service from Willits. The meeting resulted in three items of action, a solar powered hand car and a solar powered passenger car. Phil Jergensen, one of the SEER organizers and a professional car manufacturer agreed to be responsible for developing a prototype for both vehicles. The Mendocino County Railway Society is sponsoring the project which will present its progress in the form of vehicles that will be demonstrated during the 1991 SEER. Prototype development will be done under the advise of the CWR to insure that the vehicles will meet Federal Railroad Agency operating standards. The solar rail project committee consists of Phil Jergensen and Jack Boone, chairman of MCRS. The goal of the effort is to utilize solar technology to meet today's transportation needs.

In designing the vehicles Jergensen will employ regenerative braking, utilizing the weight consideration in the form of deep cycle storage batteries. One planned activity of the passenger vehicle is to operate it on a transit run from Willits to Fort Bragg and in the future operate from Willits to Ukiah. In order to develop the project in a timely manner and to utilize all available resources the committee is requesting that anyone interested in offering knowledge, advice, contacts or financial resources for the success of this project should contact Solar Rail, Mendocino County Railway Society, Emile's Station, Fort Bragg, CA 95437.

Biospherics 101

Earth-Base Projex will be sponsoring several 7 session classes starting in October 1990. The 7 sessions will cover photovoltaics, solar heating & cooling, gardening, organic greenhouses, aquaculture, grey water systems, methane digesters, and composting privies. The 7 session series costs just $35, total.

For more information contact: Terry Kok, POB 1328, Bloomington, IN 47402 • 812-336-5334 or 812-332-0048



HEAVEN'S FLAME SOLAR COOKERS

by Joseph Radabaugh

reviewed by Kathleen Jarschke-Schultze

At SEER '90' I met Joseph Radabaugh and had my first view of a Heaven's Flame solar box cooker. I purchased his book, Heaven's Flame and by reading it and following the plans for the cooker I have assembled and tested a working solar oven. So far the materials for the oven have cost me $3.37. I used anything that I already had on hand and that kept the cost way down. Had I bought everything I needed it still would have been under $10.00.

Joseph has spent the last 15 years designing and using solar ovens. The culmination of his experience is the Heaven's Flame Solar Cooker book. It is simple and interesting to read and easy to build the Heaven's Flame solar cooker. After briefly touching on the history and theory of solar cookers, the author describes the workings of different box cookers with drawings to illustrate the different qualities of each. In one chapter he answers the most often asked questions about solar cooking. I found this highly informative and, indeed, it answered my questions on the subject. The small, softcover, 41 page book is full of one man's enthusiastic love for and experience in solar cooking.

Joseph's method of construction, using cardboard boxes, does involve some searching. I have found that the produce departments of large supermarkets, small convenience stores, furniture and appliance outlets are the best places to get the cardboard you'll need. All the materials are common everyday articles. Many people who will build the Heaven's Flame solar cooker already have most of the materials on hand, as I did. In case you would like to design your own solar oven, Joseph provides a general flow diagram containing a checklist of essential components to consider. He then takes each component and discusses boundaries one must work in to obtain the efficiency needed for the oven to perform well.

Joseph describes an effective method to use recycled jars as cooking vessels.

The variety of foods that can be cooked in the oven are endless. One certain limitation is that you cannot fry foods. The oven temperatures do not get high enough. Any recipe for use in a crock pot is perfect, with no adjustments. A rule of thumb for solar cooking is that it will take twice as long to cook the dish as in a regular oven. I have had great success with beans, I didn't have to soak them first, I did get them boiling on my gas stove first then put them in the solar cooker. Vegetables need no additional water as they cook in their own juice. The thing I found I really liked was being able to start dinner in the morning and not think about it again until dinner time. You can bake bread but it takes more attention.

If you are interested in Solar ovens but can't afford the manufactured model I recommend the Heaven's Flame. Easy, informative and affordable Joseph's book will get you cooking with the sun in a short time so that your personal experience will convince you of this cooking style's utility and fun.

Joseph has a small supply of the books left. He is rewriting more of his experiences into a revised edition yet to be published. The book is $5.00. You may get a shortened one page version containing the plans for the Heaven's Flame solar cooker by sending a S.A.S.E. and $1.00 to Joseph Radabaugh,POB 1392, Mt Shasta, CA 96067.

Boundary-Layer Breakthrough - The Bladeless Tesla Turbine

Reviewed by The Wizard

This book is a compilation of articles & essays concerning a turbine and/or pump and/or compressor first designed and patented by Nikola Tesla in the early part of his century. This design has been refined and extended by C. R. "Jake" Possell. It uses the phenomenon of boundary layers drag which is a result of the properties of all fluids. These properties are adhesion & viscosity.

The Design

Basically, the design consists of a series of parallel circular plates attached to a central shaft. Each circular disk has openings close to the shaft. When configured as a turbine, the driving fluid is injected at the periphery of the plates , tangential to them. The fluid travels in a spiral path exiting at the center thus turning the shaft. When configured as a pump, the shaft is turned and the fluid travels in a spiral from center to periphery.

The Book

The book describes this in much more detail. There are also many applications noted, most of which are now in use or development. Anyone interested in turbines, pumps, compressors or Nikola Tesla disciples will enjoy this book.

Access

Boundary-Layer Breakthrough, The Bladeless Tesla Turbine; As developed by C.R."Jake" Possell; Compiled by Jeffery A. Hayes; Volume II The Tesla Technology Series. The cost is $19.95 ISBN 1-882137-019. Available from High Energy Enterprises, Inc., POB 5636, Security, CO 80931.

Electric Vehicle Access Data - *info, parts & makers*

Karen Perez

Concern for the environment coupled with the problems in the Middle East has finally resparked interest in electric vehicles. About time too! In the last two months we have received hundreds of letters from folks wanting more information. So for everyone who's tired of burning dead dinosaurs, here's an active list of suppliers, in no particular order.

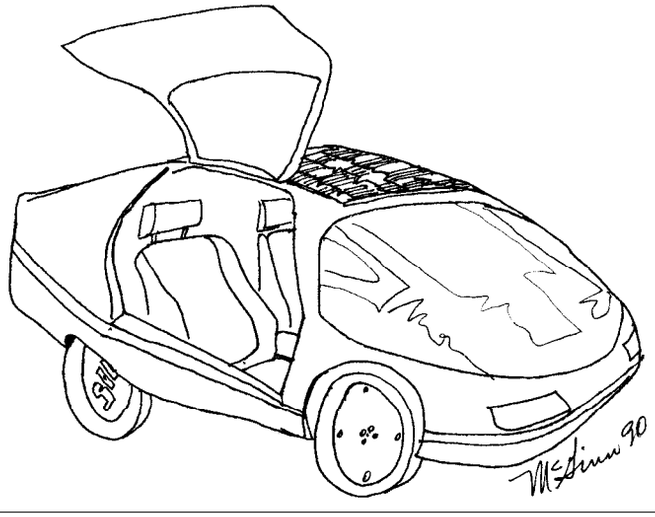
Electro Automotive
"Convert It" is a step-by-step manual for converting a gas car to electric power. This manual has received kudos from John Newell of the Electric Auto Assoc. and Professor W. Robert Kincheloe, Stanford University. The manual sells for $35 +tax and shipping. Electro Automotive also sells the parts needed for a conversion, catalog $5.00 (refundable w/order of $25 or more). Doug Brown or Sheri Prange, Electro Automotive, POB 1113, Felton, CA 95018-1113 • 408-429-1989.

Kaylor Energy Products
Kaylor Energy Products sells electric vehicle conversion kits, parts, books, videos, brochures & blueprints. For more information send SASE to Kaylor Energy Products, 20,000 Big Basin Way, Boulder Creek, CA 95006 • 408-338-2200

Solar Car Corporation
Doug Cobb and his crew at Solar Car Corp. are working on production model solar conversions. They expect to have the first models ready for sale in the summer of 1991. Solar Car Corp. is working on a converted Dodge Colt, a mini-van, a multi-passenger van that will carry 14-16 people and a sports car. For more information contact: Doug Cobb, Solar Car Corp., 1012 E. Lincoln Ave., Melbourne, FL 32901 • 407-725-3769

Solectria, Inc.
Solectria plans to make a limited number of solar-assisted EVs in the next year. Depending on demand, everything from a 3 wheel commuter ($8,000) to a mini-van ($24,000). Solectria also sells EV parts. For more information contact James Worden or Anita Rajan, Solectria, 27 Jason St., Arlington, MA 02174 • 617-894-6670 or 617-646-8303

Solar Electric
Solar Electric is currently selling electric bicycles, mopeds, converted compacts, converted full-size cars, vans and sports cars. Prices start at $975 for the bicycle (12 mph, 40 mile range) to the Stardrive 2000, $25,000 (60-70 mph, 60-80 mile range). Their compact Renault or Honda conversion starts at $5,500 (50-55 mph, 50-55 mile range). For a complete list of available models contact Dan Klepper, Solar Electric, 175 Cascade Ct., Rohnert Park, CA 94928 • 707-586-1987



Suntools
Suntools carries the parts for building an electric vehicle from the ground up. The $20.00 catalog includes tires, permanent magnet motors, box beam framing, bearings, hubs and more. The catalog also has a section on building EVs. Contact, John Takes, Suntools, 1258 N. Main St. Unit B2B, Fort Bragg, CA 95437 • 707-964-9019

Clark Beasley
Clark is the designer of the SlingShot (see pg 14). Richard took a spin in it at SEER'90. I've never seen him look so happy. Clark has a book with step-by-step instructions notes, photos, design tips, race event rules and descriptions of the evolution of his 4 racers. This 32 page book called Challenging the Electrathon: Design, Build, and Drive an Electric Racer can be purchased for $11.95 from Clark Beasley, 23725 Oakheath Place, Harbor City, CA 90170 • 213-539-9223

Solar Mind
Joe Stevenson sells EV parts and older electric vehicles. He also has a newsletter with a holistic view to appropriate transportation technology. Solar Mind, Attn: J. Stevenson, 759 South State St. #81, Ukiah, CA 95482 • 707-937-4352 or 707-468-9535

Sol Sisters

Let's exchange ideas about the more feminine aspects of renewable energy. This is not meant to be sexist. Anyone can cook, do housework or install a PV.

Traditionally Speaking

A large part of non-grid produced power is used for household chores, traditionally done by the ladies of the world. These ladies have been conned into believing that electricity is just too technical. Not so! In our small neighborhood over half of the RE systems are operated and maintained by the lady of the house. It's a matter of need and interest. Energy is non-sexist, it doesn't care whether you're male or female. After talking to a lot of RE using and installing ladies at SEER '90 the only difference we could come up with is upper body strength, and there's ways around that one.

How many times have you been asked "How can you do without (insert anything from a hair dryer to vacuum)?" Sharing experiences could sure make answering these questions easier while helping to convince the skeptics that they can do it too. We're not the lunatic fringe!!

Sharing

Through Sol Sisters we'd like to share info on a variety of domestic topics. Here's a sample of what we have in mind-- solar cooking, test reports on kitchen and household appliances, problems encountered living off the grid and ways around 'em.

For A List

While at SEER and MREF, 26 ladies signed up for Sol Sisters. If you would like there names and addresses send me an SASE. Networking is important, we're not alone!!

Access

Karen Perez, C/O Home Power, POB 130, Hornbrook, CA 96044 • 916-475-3179.

A Different View

Here's some ideas regarding the "Solar Sister" group from Katcha Sanderson.

Call it the Solar Sister Society, the motto being Strengthening Solar-Esteem Through Sharing. I have an idea for a logo. The logo is built off of three interlocking "S-links" out of which the name Solar Sister Society reads. To complete the "chain" I would like to see a link of suns. This represents that we sisters are NOT the weak links in the chain! In fact we can help complete it.

What I think would be meaningful would be to have a small newsletter, perhaps quarter (on the solstices!) which could serve as a clearing house for idea exchange. Developing a tradition of saying what will be missed in the last season and what looked forward in the next would help to orient thinking to the OUTside world. Plus be a reminder for seasonal "duties" - panel adjusting./cleaning, water considerations, better solar day activities, etc..... It could also be used for connecting Solar Sisters with one another. To that end I should like to see a list of "Support Sisters" who would be available to write and/or talk to those "Novas" (novice sisters) looking for someone they can learn from, woman to woman. This accomplished either by letter writing (not more than once a month!) between them or perhaps a 5 or 10 minute chat on a Saturday morning when the rates are lowest. The ultimate goal could be to meet once a year (Willits?) and put together a demo/project which could be done by the Support Sisters and Novas together which could show not only that we CAN do it but also that it can work FOR us! Newsletter costs ($4 yr. + $5 one time fee for entering onto database) could defray its cost at a reasonable rate and compensate the person taking on this task. This could be done on a yearly, overturning basis (secretary) or a constant editor (cottage industry opportunity for a member).

Access

Katcha Sanderson, 20295 Panoche Rd., Paicines, CA 95043

And another…

My husband and I got our issue #1 of HOME POWER at the local laundromat in Yreka. He read it and liked it. I did not read it. I assumed it was some sort of technical magazine on 'things electrical'. Although I had been living on AE (microhydro) for years my interest and expertise remained basic.I learned to check the nozzle at the hydro plant before climbing the mountain behind our cabin to check the head. I learned to check the battery water when my husband was gone on a job. I learned to turn off lights when I left the room and to use the vacuum cleaner quickly. Also, how to coax the most hot water from our summer passive DHW system. This was the extent of my knowledge and interest. We began to receive HPs regularly and I did flip through them but nothing really caught my eye, to me it was just another technical manual for my husband.

Then came issue #7. On page 15 was an article on solar ovens. I was fascinated. After I read that article and found it easy to understand I looked, really looked, at the other articles. They were good. I could understand and see the relevance of most of them. I got all the back issues and read them. Wow! I'd been missing a lot. By issue #10 Bob-O was encouraging me to submit an article.

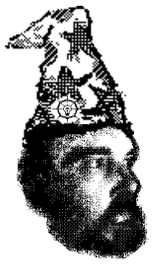
My friend, Sarah, had been wanting a passive solar water heater like ours so we built one at her house, I wrote the article and she did the artwork. The article appears in issue #11 on page 19. I was very pleased that someone used my article build and use the DHW system (see Letters to HP).

As I met the HP crew and became more involved I have to admit my life has changed, for the better. I helped build the solar cooker on the cover of issue # 12 and it is one of a couple of solar ovens that I now use. Awareness of available energy and appropriate use of same. We can all do it!

I have built and tested an easy, inexpensive solar oven design (article to come next issue). This subject continues to fascinate me. I would like to hear from other solar cooking enthusiasts and start a collection of recipes to test for future publication. To share the knowledge and excitement is fine indeed and quite rewarding.

Access

Kathleen Jarschke-Schultze, 19101 Camp Creek, Hornbrook, CA 96044 • 916-475-3401.



The Wizard Speaks…

What Can Be Done?

We should get off our duffs and force the utility companies to install 1 watt of solar power for every 200 kilo-watt hrs of energy that they sell.This is a modest proposal. It may increase grid utility costs by 15 to 30 percent. This increase can be made up by conservation and use of efficient electrical appliances. Use of efficient lighting and refrigeration along with awareness of phantom loads could potentially decrease present household usage by as much as 50%. We have got to start somewhere. Here's a place to do it.

The second thing that needs to be done is to force the large auto makers to produce hybrid electric vehicles instead of gas-guzzling monstrosities. Solar electric cars with small gasoline powered electric generators can greatly reduce pollution and energy consumption. If we can put a man on the moon any technological problems associated with the above would be child's play.

They say forewarned is forearmed. Well, we've been forewarned. It's now time to become forearmed. The Doomsday clock is still environmentally ticking. The alarm has gone off. Let's not be late.

Writing for Home Power Magazine

Home Power specializes in hands-on, practical information about small-scale renewable energy production and use. We try to present technical material in an easy to understand and easy to use format. If you want to contribute info to Home Power, then here's how it is done…

Informational Content

Please include all the details! Be specific! Write from your direct experience- Home Power is hands-on! We like our articles to be detailed enough so that a reader can actually apply the information. Please include full access data for equipment mentioned in your article. Home Power readers are doers. They want access data for the products you mention in your article.

Article Style and Length

Home Power articles can be between 500 and 10,000 words. Length depends what you have to say. Say it in as few words as possible. We prefer simple declarative sentences that are short and to the point. We like the generous use of **Sub-Headings** to organize the information. We highly recommend writing from within an *outline*. Check out articles printed in Home Power. After you've studied a few, you will get the feeling of our style. Please send a double spaced, typewritten copy if possible. If not, please print.

Editing

We reserve the right to edit all articles for accuracy, length, and basic English. We will try to do the minimum editing possible. You can help by keeping your sentences short and simple. We get over two times more articles submitted than we can print. The most useful, specific and organized get printed first.

Photographs

We can work from any photographic print. The best results happen if we have a black & white print rather than color. We can work from a negative if necessary.

Line Art

We can work from your camera-ready art. We can also scan your art into our computers, or even redraw it via computer. We usually redraw art from the author's rough sketches. We can generate tables, charts, and graphs from your data.

Got a Computer?

We would like your article on computer disk if possible. This not only saves time, but also reduces typos. We use Macintosh computers. Please format all word processor files in "TEXT" format. We can also read text files on 3.5" IBM disks. Please format the IBM word processor file as ASCII "TEXT". Format all graphics in either PICT, EPS, or TIFF formats. Use the Helvetica 9 point font for all text embedded within graphics.

What your material returned?

Please include a stamped, self-addressed, return envelope. Otherwise your material will not be returned.

Copyrighting

If you request it, we will copyright your work in your name. Otherwise we will copyright the information in Home Power's name. The copyright on your material is yours for the asking.

Got any questions?

Give us a call at 916-475-3179. This saves everyone's time.

RP

Letters to Home Power

We Print 'em Unedited.
Selected & Entered by
Kathleen Jarschke-Schultze

BOB ANSWERS

Jim Miller's question about using a Danfoss compressor for air conditioning. The answer is NO. The reasons are simple, and those dealing with capacity, not current draw.

The Danfoss compressor is BTU rated at less than 1000. To adequately cool even a small space of 2500 cu. ft., would require a unit with a rating of 8000 BTUs. Even using one of the more efficient refrigerants compatible with the Danfoss, would leave it far short of these requirements.

Danfoss designed the compressor for use in refrigerators and freezers of small capacities (7 cu. ft. average) super-insulated, and sealed from external environment. Note the construction and efficiency of "SunFrost" appliances.

We hope this answers your questions, Jim, and any others who may have come up with similar ones.

Bob McCormick, N.A.P.S. Pink Mountain, B.C. Canada

12V WELL PUMP

Dear People: For the past 16 years I have lived the simple life (we all know it is not simple at all). The first ten years I had no electricity. Slowly, I have gotten a wind and PV set up with a large bank of batteries. I believe we who are experiencing this way of living are setting the stage for a necessary future. Home Power Magazine is a welcome addition.

At present, I pump my water by hand. I have a 4 inch well casing and a 60 foot well. Does anyone know where I can get a 12 volt DC deep well pump. It appears that larger models are made for commercial applications but not for the home. Help.

John Weber, Long Prairie, MN

DC powered submersible pumps are available, John, and they can run from PV arrays direct and/or from batteries. Either Windy Dankoff at Flowlight Solar Power, POB 548 Santa Cruz, NM 87567 (505) 753-8474 Or Jim Allen at Solar Pumping Products, 325 E Main, Safford, AZ 85546 (602) 428-1092 . KJS

HOMEBREW HOT WATER

Dear Home Power Friends; I met you at the Earth Day festivities in Mt. Shasta and took a picture of your booth (enclosed). I also built the solar water heater from Kathleen's plans (issue #11) and it works well except that I want to put it up on the flat roof where it will get sun all day, so I will need a slow flow pump to bring the water down to the tank. Can you recommend one?

Thanks for your great magazine and your help. Sincerely, Randy Bofinger, Mt. Shasta CA

I remember meeting you, Randy, and the discussion we had on building the DHW heater. I am gratified that you did assemble one from the article. See Windy Dankoff's access info after the previous letter for your pump question. Thanks for the pix. KJS

Battery Recharging

Your magazine has given me a lot of help and understanding. I have recently acquired 40 used batteries for a very good price, free. Perhaps you have some information that would help me. The batteries are 6 volt Powersafe RE Chloride with these ID marks on them, SRC 2990, 3VB7, 3VB9, and 3VB11. Will they work fine for an AE system? They appear to be totally sealed. Do they produce harmful gas? What is the storage capacity? Enclosed is my check for a real subscription. Ronald Borries, Bellingham, WA

They will work just fine, Ronald. They are sealed and will stay that way provided you don't charge them to distraction. They should be recharged at no faster than the C/10 rate. Otherwise, they may produce more gas than their internal recombination mechanisms can handle, then they will vent. So if you don't recharge them too quickly, they will not out gas. Sorry no info on their capacity, contact a Chloride dealer for that info. RP

Batteries as Toxic Waste

Dear Home Power: I work for the communications department of a large corporation. We use a lot of storage batteries. I know many HP readers and HAM radio operators have been able to get used batteries free for the asking in the past from such companies when they are replaced and retired from service.

My message is: Grab 'em while you can! My company doesn't exactly lead the field in forward vision and environmental awareness (to put it mildly), yet we now have to handle storage batteries as hazardous waste! We can no longer give them away, according to policy we now PAY authorized hazardous waste people to dispose of them for us. I don't know what caused my company to take such drastic action nor do I know where government regulations stand. My point is -- If this is the direction industry will take on disposal of batteries in the future, think twice before passing up any freebies!

John Spence, Silsbee, TX

And it's about time.that regulation were placed on the disposal of all batteries. These beasties are environmentally hazardous by design. If they weren't chemically reactive, then they wouldn't be batteries. Industry, as well as home power people, need to properly dispose of all chemical wastes- including batteries. Government regulation of battery disposal is increasing and freebie cells are becoming a thing of the past. Maybe it's just as well, I'd rather have a clean world and pay a little more for my batteries. RP

WHISPERING WIND

Dear Sirs: Hi there from atop our little ridge in northeastern Washington state. We are avid fans of your magazine and we think you are doing great things. The information contained in your magazine has made life much easier when it came to setting up and expanding our solar energy system.

Right now we are considering purchasing a wind generator. We have several in mind and have been able to find plenty of data and test results on all of them except the Whisper 1000 offered by Kansas Wind Power. Do you know of any test data available? It looks good in the sales brochure but we'd like to know more about the actual performance. Any information you can provide us with would be most helpful. Keep up the great work!

T L Hotchkiss,Newport, WA

We don't have any personal experience with the Whisper 1000. But

on our journey to the Midwest Energy Fair, we heard of and saw several Whisper based systems in the area. Wind Wizards at MREF said that the Whispers worked well. Perhaps our more knowledgeable readers could share their practical observations. Also, you might try Mick Sagrillo at Lake Michigan Wind & Sun, 3971 E Bluebird Rd, Forrestville, WI 54213 (414) 837-2267 KJS

STIRLING QUALITIES

Dear Home Power: When I eventually complete other more pressing projects I would like to use some of the abundant wood in my area for electricity production as a complement to my solar panels during extended periods of cloudy weather.

I have just recently heard about a "sterling engine" which seems to have potential in this area. Apparently, the engine runs on temperature differentials. I know so little about this engine I'm not even certain the name is correct. Are any of your readers knowledgeable on this subject? I would be especially interested in a critique of this engine vs the steam engine as a power source for driving an alternator. Thanks, Mason Hess, Tonasket, WA

The best you could do is to contact Christopher Sheck, Stirling Technology Inc., 9 Factory St. Athens, OH 45701 (614) 594-2277. They are the makers of the engines and the answers you seek. KJS

COOKIN' CATAMARAN NETS

Dear Richard and Karen, I'm the fellow building the catamaran to solo, non-stop around the world at the equator, talking to folks along the way on ham radio about solar box cookers. Hello again. HP continues ,to make a great contribution to my life and to the project. Thank you very much!

William Oldfield's article in #18 was especially interesting since, with PV, wind and water generation on the cat, I've been concerned with protecting the batteries. Looks like Chris's shunt is just the thing!

A question please: We at Solar Box Cookers Northwest would like to get in touch with the Sustainable Energy Education Network which was mentioned in the article on the Oregon Country Fair. Given that we're all doing solar cooking, we'd like to pool our thoughts and perhaps some mutual support.

Here's something for you to know. In the same way that very high tech PVs allow for more possibility in life, SCBN has begun to use PeaceNet to spread the word about solar box cookers worldwide. Through PeaceNet electronic bulletin board net we're in touch with:

Alternex in Brazil
FredsNet in Sweden
GreenNet in England
EcoNet, HomeoNet and ConflictNet in the US
Nicarao in Nicaragua
Pegasus/ Earthnet in Australia
Web in Canada

Through the networks, all of which are interconnected, we were able to send plans to national Earthday coordinators in over 40 countries.

SBCN is part of a conference called AT:General. Our newsletters and other documents are part of another, AT:Library. (AT = Appropriate Technology). You get the idea. I don't know if you can use this in your work, or if any of the folks you're in contact with could use a wider stage, but if so, the address is:

Institute for Global Communications
3228 Sacramento St.
San Francisco, CA 94115

All it takes is a computer, a modem and $10- a month minimum charge. Regards, Bill Masciarelli, Seattle, WA

It is a wonderful and adventurous thing you are doing, Bill, and we salute you. The interest in solar box cookers is snowballing as you can see from the article in this issue. Sustainable Energy Education Network access info is: Christopher Williams, POB 7244, Santa Cruz, CA 95061.

12V SEWING MACHINE CONVERSION

Dear Home Power, I converted my sewing machine to 12 volt. I did put it on a treadle base for a while, but it took up too much space and I like to have both hands free when starting seams. The conversion to either method will work with any machine that has a visible motor and belt. Unless you are very brave and own a hacksaw!

I used a car blower motor (used $15) and a universal horn button on a 2x4 scrap for the foot pedal. The motor was mounted in line with the hand wheel on a block of wood in the portable base. It was put in the holder for the cord and pedal (when not in use). Blower motors can turn either way, just reverse the wires, so you can put it in the back where the original motor was or out the side. Use the lines on the old motor to give you an estimate for the 12 volt wire lengths to the pedal and and outlet. You can even put a small on/off switch near the machine, right on the wires, if you want to get fancy. Attach the wires to a suitable "plug" for your system. (Make sure the pulley off original motor will fit the 12 volt motor shaft).

Blower motors do use a lot of electricity, but sewing involves a lot of starting and stopping, even in production work, while you line up the pieces or turn things around. I ran my machine off the car battery before I got a PV panel.

Leave the battery in the car, securely attach heavy gauge wire to each terminal and run the wires out the grill to the outside front of your car. Attach the ends to a large three prong receptacle. This can be tied to the bumper so it doesn't flop around while driving. Now connect the wires from the house (or whatever) to a large, three prong plug. Be ABSOLUTELY sure to match the polarities. Drive up and plug in. This system works well if you use the car regularly, like on weekdays. It prevents accidental polarity crossing and your hood stays closed, keeping out the rain and snow. Just don't forget to unplug before driving off. I thank you for all the wonderful information and encouragement you provide. Blessed be & Happy sewing, Denise Peterson, Placitas, NM

Thank you, Denise, for a wonderful letter. As you have shown our needs can sometimes be met with simple ingenuity. Alternative life styles bring about alternative solutions to the needs of many. KJS

Steam and Thermoelectric Stuff

Dear Richard & Karen, Once again I write & enclose money, to replace mysteriously disappearing old Home Power Magazine issues: to wit #2,3,4,6. While I confess to being a relative late-comer and never having owned issues 1-7, I swear that I recently had to write you and replace one of the latter 3 above. Wish I knew what was going on as I am certainly the epitome of a neat housekeeper, par excellence. Do you have some type of home coming pigeon device on these, or am I no longer to trust my friends and neighbors and begin locking our cabin for the first time in twelve years, or what?

And now I see that issues 5 and 7 (and 1) are "no longer available" and most probably, given my type of luck, those are just the ones I need. For there are currently two devices/techniques high on my personal priority list and not dealt with in those few issues still in my possession:

My 1st concern can hardly be said to be found on the "cutting Edge"

of home power technology, namely the once fashionable (now ridiculed?) back up system consisting of an auxiliary (eg. Les Schwab) 12 volt battery in a vehicle-to-house 12V system (during those long dark winter weeks when we have to drive our daughter down to the nearest school bus stop [twice a day= 7 1/2 RT] during which there is a 1,700' change in elevation= 4x4, low transfer chained up on all 4 wheels, most of the time). I suspect your 1st issue (or #5?) had a good blue print/description of how to rig up such a system way back when. If so , could I buy a photocopy - or do you know of another good source? (and, who knows, maybe this old backup system has been refined/upgraded to the point of being fashionable again?)

Priority #2 has to do with the 6-8 cords of solid fuel (ie firewood, and-yes- after 12+ winters, much of the thrill has gone...) we have to put through our two stoves every winter (heating, cooking). I just can't believe that someone hasn't yet come up with a way of using all this energy to charge batteries (again - during those long , cold, dark winter days when the sun don't shine, the wind don't blow and our creek is well nigh froze up solid...). HP issue # 8-18 (correct me if I'm wrong) have little or nothing to say about this- with the exception of your (rather discouraging) exchange, in the letters section, with Steve Robinson in issue #16, p.56. Well, if-as you state- "..thermovoltaic technology is not yet mature" [and based on our personal experience some 4 years ago with a $135.oo OVONIC "Thermoelectric generator" (stove top device) I'd say you were right] then how about some good old fashioned boiling water (ie. steam power) device to do the trick?! From between 50 to 100+ years ago much of the energy to run lights came from a fortuitous combination of wood and water (the narrow gauge railroads for example). We may be changing from firewood to wood pellets or some other technique but the potential and the challenge will remain the same as I see it. So are we missing the boat or is it just me (once again) that's missing something? Can I hear our ancestors (who did have electrical energy from wood) laughing to beat the band as our technicians struggle with pathetic solid-state peltier junctions? I say onward!- even if it means going backward. Respectfully, "Nick' Frazier Nichol, John Day, OR

P.S. For the record Linda and I greatly admire and appreciate what you and all contributors to this magazine are doing.

P.S.S. My issues # 12,13,15 just turned up in one of my Home Power "special issue" file- where I had carefully placed them. I didn't plan on buying a padlock anyway...

Well, Nick, you can relax. To date we have not done an article on steam power. As you can see from a previous letter in this column there is a definite interest in using wood to produce electricity once more. And we've never run info on a dual system for a car, but it is ultrasimple, just use a battery isolator found in just about any RV catalog. KJS & RP.

SELECT-A-TENNA FAN

Dear Home Power,I was interested in seeing the Select-A-Tenna written up in Home Power. My father gave me a Select-A-Tenna over 12 years ago for my AM radio since we lived in a steep, rocky canyon in the Hell's Canyon area of Idaho.I was over 50 miles from the closest radio station. It works wonders as I have used it constantly and in various remote locations. I regularly receive the Moscow, Idaho public radio station and now use the select-A-Tenna inside the Salmon River canyon.

The batteries last longer on the radio as you can turn down the sound because the reception is so excellent. Mine looks exactly the same as the one in your picture. It has had many abuses and hasn't cracked, chipped or lost any reception abilities at all.

Any back country user can delight in this link with civilization. I now use a "back country booster" set-up on my radio that attaches to the radio and wires to antenna wire outside, but the Select-A-Tenna still does the best boosting! The price seems high, but it is definitely worth it and a wonderful gift for friends or family who miss out on good radio. I'm sure my father had a Select-A-Tenna that worked for FM and was wondering if they still made these? Glad to have the address to order more. Just read the Crane ad. Will be ordering a FM booster soon! I appreciate the ad being by the article. Sincerely, Mary Nuckols, Riggins,ID

Great letter, Mary, it is always wonderful to hear from a satisfied user of products that fit into the alternative life style to which a lot of our readers subscribe. After 12 years of use and abuse it would seem that you have the expertise recommend this product. KJS

MREF UPDATE

Dear Home Power Magazine, Organizers of the Midwest Energy Fair wish to thank HOME POWER MAGAZINE and Richard and Karen Perez for supporting this event. We especially thank you for moral and financial support, free advertising, mail lists, phone call, making the trip to Wisconsin, speaking, presenting workshops and helping us keep smiling despite the weather. We feel the fair was incredibly successful with 4000 people attending events over a three day period. During and in the weeks following the fair we have just begun to realize the public need and demand for information on renewable energy & energy conservation.

Although events in the Mideast have effected awareness (it seems all the politicians and media folks are suddenly waking up), we think this interest goes beyond that. In response, we have already begun planning for next year's Midwest Renewable Energy Fair on June 21-23, 1991. We continue to look for new volunteers to join our group of renewable energy advocates (and fanatics). For now you may continue to contact us at: Midwest Renewable Energy Fair, 286 Wilson St, Amherst,WI 54406 or (715) 592-4458.

Thanks again to HOME POWER. Without you none of this would have happened! Sincerely, The Energized MREF Coordinating Committee

Wow! Everyone in our HP crew who attended the MREF came back with wonderous tales of an incredibly energetic core of movers and shakers back there in Wisconsin. Be prepared, because next year even more of the crew is going to be attending. And, THANK YOU, THANK YOU! KJS

CODE CONCERNS

Dear Home Power, I am concerned that your "Code Corner" articles might cause dangerous situations by alienating home power users. Note the parallel between "Reefer Madness" and an intelligent understanding of the drug problem.

I am all for safe wiring practices. However, when I hear of code requirements to run 4/0 grounding cables to ones solar panel frames (perhaps 300 ft away) I question the wisdom of the whole code and those who advocate it. (Ref. pg 27 of HP#18, line 3 and pg 26, 16th from last line.)

There are safe wiring practices that are economical. I believe that home power innovators will not and should not accept poorly explained regulations or those which are expensive with marginal benefits. I believe that we must guard against and reject inappropriate and confusing regulations and do all in our power to prevent their enactment.

With appreciation for your fine magazine, Bob Stille, Los Gatos, CA

I agree, Bob. Check out the Inverter Shootout article in this issue for a graphic example of what over-engineered "safety" can do. Frankly, I question Mr Wiles' motives. I understand that he is installing one of these supersafe systems in his own home. Hopefully, when he figures out why his inverter won't boot up his wife's washing machine, he'll get the picture. The NEC does require that the grounding wire be at least as large as the largest conductor in the system. On the other hand, the NEC doesn't require grounding at all in systems under 50 VDC. You figure it out. Personally, I feel that a ground wire as large as your PV-to-Charge Controller feeders and grounded at or near the PVs should be adequate. In my own system, I use such a ground and fused Disconnects at the PVs, between the Controller and the batteries, and between the inverter AC output and my mains panel. All exposed wires are in conduit. I can live with all that, it's safe and it doesn't degrade the system performance to an appreciable degree. I refuse to put anything between the batteries and the inverter that will either a) affect it's performance or b) be as costly as the inverter itself. Especially when you consider that nearly all of today's efficient inverters have fuses and breakers already on-board to protect themselves! Bob-O

A VIEW OF EUROPE

Dear Karen, Thanks for the quick turnaround on my order for a subscription and all your back numbers. I can see once I've digested the magazines I'm going to have a pretty good education in alternative energy.

You asked if I'm seeing much interest in solar energy in West Germany. I'm sure you're aware of the recent buyout of ARCO Solar by Siemans, possibly the world's largest electronics conglomerate. Siemans is a West German corporation.

I can't say I've noticed a lot of solar collector arrays in Germany, but I've seen plenty of wind-driven generators. The further north you get in Europe, especially along the Scandinavian coastlines, the more big wind machines you see.

You've probably heard of the Green Party, an environmentally aggressive political group here in Germany. The party is very vocal and still growing. With the incredible opening of the East in the past 10 months and with German reunification virtually assured, I see environmental concerns and action moving center stage in Europe and staying there for a very long time to come. On the other side of the "Iron Curtain" are lands and waters so destroyed with pollution and other abuses they make Professor Tolkien's Mordor look like a national park. Cleaning up the Warsaw Pact countries from now on represents a much bigger challenge than salvaging their foundering economies. We've just been handed an unprecedented opportunity to start over and maybe get it right this time.

What we learn from the experience of recovering the environment of Eastern Europe will have world-wide implications and applications. Speaking strictly as an optimist, I think we'll look back 50 short years from now and see a miracle coming out of this challenge which will be even more impressive than the recoveries of the German and Japanese economies since 1945. Hopefully we in the States will learn from the experience and apply the lessons too.

Let me close before I get too editorial on you. I've got a lot of magazines to read. Thanks again for sending them so quickly! Sincerely, Lt Col Robert Sunde,Jr APO NY

I am hoping you are right, Robert, it sounds as though a miracle is needed. Thank you for an eagle eye view of the East European plight. Necessity is the mother of invention and as crew members on the Planet Earth it is necessary that we do utilize the technology we have and develop even more to keep this ship balanced and empowered with ALL life as we know it. KJS

CAREIRS

With the sizzling heat of summer still baking most of the nation, the memories of cold winter winds and high heating bills have probably faded in the minds of most consumers. But with autumn approaching, homeowners may want to start taking measures to reduce costs for heating.

Many of these measures can be inexpensive. For example, Caulking and weather stripping are relatively low-cost ways that consumers may reduce heating bills and increase comfort this winter.

Insulating, though more costly, is another energy-efficient measure that can be taken. Installation can be done as a do-it-yourself project, or by a professional contractor. In either case, it is important to choose and install the insulation correctly.

The Conservation and Renewable Energy Inquiry and Referral Service (CAREIRS) is distributing two free fact sheets, "Caulking and Weather stripping" (FS203) and "Insulation" (FS142) which not only discuss these conservation measures in more detail, but also provide purchasing and installation tips. For more information on these publications, refer to the enclosed releases.

We would appreciate your assistance in publicizing CAREIRS by mentioning our Service and publications in an article or information column. If you have any questions, do not hesitate to call me at (703) 243-4900 or (800) 523-2929. Sincerely, Christopher DeChaine, Silver Spring, MD

Consider it done, Chris. You readers who are interested can obtain the flyers by writing to CAREIRS, POB 8900, Silver spring, MD 20907 KJS

12V WIRING AND THE TRACE

Dear Friends, I was at Amherst and had an enjoyable two days. I learned a lot but I still have one question which I never got clarified. My home is completed with conventional AC wiring, 14 ga. for lighting and 12 ga. for outlets. According to the way I read some of your articles dealing with this, I should be able to add PV panels, batteries and inverter wired into my house wiring and be off and running. I understand that I'll have to modify my electrical use as described in HP#14 page 11 and may even isolate the circuit to our washer to keep it on the power grid. My question is, do I have to make any changes to the size of my wiring or to any of my switches or outlets when changing over. I'm also aware that if I go with 12 VDC or 24 VDC I would be able to power everything more efficiently but for the cost of change over and the nightmare of rewiring I'm thinking that installing a few extra PV panels would offset this. Your opinion on this would be most appreciated.

The enclosed check is for the following back issues, 2,3,4,6,8,9,10,11,12,15 &17. I enjoyed your talk at the Midwest Renewable Energy Fair and I bought some of your magazines and now I'm hooked. Keep up the good work.

P.S. Is the Trace 2524 ,with options, as described in HP#16, going to allow power stored in batteries to supply my home with 110 VAC and when they (the batteries) get low will the Trace's battery charger option automatically kick in to recharge them? Or will the Trace automatically switch me over to grid power if I so desire?

I would think the best situation would be to use PV stored power until down to a set level and then automatically switch to grid power until batteries are charged again by PVs at which time the inverter switches back off grid power.

Thanks Again! Steve & Linda Sventek, Frederic, WI

Dear Steve & Linda, #14 AWG copper wire is fine for your AC lighting circuits if fused for not more than 15 Amps. #12 AWG is required for small appliance circuits (like in kitchens) and should be fused for not more than 20 Amps. DC lighting is somewhat more efficient, but you're right in assuming that rewiring and changing switches in an already existing structure would be a chore. With present day inverter efficiencies at 90+, it's hardly worth it, and an extra PV or two will surely be enough to offset the difference. Whether you use DC or AC lighting, they should still be energy-efficient types. The Trace 2524 with the Standby Charger (SB) option will use your batteries to supply your home with 110 VAC until the batteries get down a preset voltage. At that point, it will switch over to Charger mode and recharge the batteries if it has 117VAC at its input. When the batteries get back up to a preset voltage, the Trace will switch back to inverter mode. Both the low voltage and high voltage transfer levels are user programmable and adjustable. Bob-O

WELL AND GOOD

Dear Home Power, I am writing in regards to Windy Dankoff's article in issue #17 pp 25 (running submersible well pumps on inverter power). First, let me tell you that it can be accomplished- But one may encounter several problems in the process. So your readers might learn from my mistakes, I'll tell you what I experienced.
1) My well is 346' deep, static water level is 159' & produces 7 gpm
2) Have a Trace 2012 w/ standby and turbo fan (12V) 4/0 copper cable, distance to batteries-7 feet
3) Batteries- 1500AH, golf cart (these are used and at approximately 80% capacity-can't afford good ones yet)
4) System set-up - 44 gal pressure tank w/14 gal draw down, 20/40 pressure switch
5) Pump- Webtrol, model #515513B, 115V, 3 wire, 5 GPM, 1/2 HP, 13 stages (the number of stages is critical in the pump from deep wells) the pump is at a depth of 250'
6) Control box- Franklin electric (old style- not solid state, again this is critical) capacitor #275461-101 (250-300 MFD), General Electric relay #155031-101 (3ARR3-J7J4)
7) Wire- from pump to top of well- 250' #8 gauge 3 wire- well pump wire -from well casing to control box- 30' #10 gauge UF cable -from control box direct to inverter- 40' #10 gauge UF cable

My advice to readers:
1) The voltage of the pump and HP is not very important- the number of stages in the pump is where it gets it's power- the 115V/13 stage pump works ten times better than a 230V/6 stage pump (which I used while two pumps where sent back to the factory to be tested)
2) Use only the old style box (control box)- as mentioned in the article, solid state boxes won't handle the voltage dip- parts for the old boxes are still readily available once you find the box (I had to go to 3 shops and found one on the "back shelf")
3) Use HEAVY wire- I would recommend #8 gauge from the pump all the way to the inverter if possible. The inverter's characteristics are not exactly like commercial power, and with the initial voltage dip to start the pump, the inverter won't transfer the pump from the "starter" phase to the "run" phase. The 1/2 HP pump rated at 11.6 Amps max and 5.8 continuous, was running constantly at 14.0 Amps and would shut down the Trace after about 10-20 seconds.

The following took me 2 1/2 months of hard work and frustration to finally get it right. First assume the well driver and the pump supplier don't know or understand what you're doing. By following what they see as the customary way of installing the pump, you'll probably never get it to work, because they most likely haven't ever installed pumps to run off an inverter.

The well driver and I installed the pump- 300' deep w/12GA wire and 10GA into the house. It didn't work, but would run on the 6000 W generator (just barely). So I raised the pump to 200' and ran two 12 GA wires down to it (actually 200'/12 GA and 100'/10GA- one run). Still wouldn't work.

I had an electrician check the system and found out both the inverter and the gas generator were putting out 123V w/ 114V in the line circuit. But the pump was running constantly at 14 Amps and kept overloading the inverter.

Meanwhile, the 1st pump didn't have a check valve seal and had to go back to the factory. And the pump shaft on the second pump was bent so it seized up and had to go back to the factory.

This was when the supply house started blaming the Trace 2012 for the problems. So I tested the Trace by hooking up the microwave oven (1200 W), TV (100 W) electric drill (360 W) & miscellaneous, all at the same time- believe me, the Trace is one fantastic piece of equipment. < almost 3000 Watts continuous.

For the two and a half weeks while I waited to see what the factory had to say about their pumps I used a 230V/6 stage pump run directly from the generator. That pump could not bring the pressure tank up to 40 PSI, which the 115V/13 stage easily could do in about 2 1/2 min when working properly.

After the tests came back from the factory- which told the supplier that the pumps were defective and not this customer- and to immediately replace this pump with another- the supplier did. And the supplier did a lot of apologizing in the process.

Installing the third pump I made some significant changes 1) used the old style control box instead of the solid state type and 2) used #8 GA wire for the 250' in the well. Each pump has instructions on calculating what size wire to use- follow it religiously.

When I plugged the third pump in it worked! And has worked great since. Draws about 5-6 amps and runs at about 700 Watts- just what it's supposed to do.

I have a Maytag automatic washing machine with a 3/4 to 1 HP motor. I know the inverter will run that w/o much problem, but I've never run both the well and washing machine at the same time. My guess is the Trace will do it unless both motors start at the same time- that may be the next letter I write to you. For now though, I'll just run the washing machine from the gas generator- only wash clothes once a week and have to keep the generator bearings oiled anyway. That's the only work the generator does now that the Trace 2012 pumps the water.

P.S. I had to try both the washer & pump together before I sent you the letter. Didn't work. The washing machine cycle is approximately 24 min total (12 min on the wash cycle). The inverter made it to about 10 min on the wash cycle, then the turbo fan came on for about 10 seconds and went off, about 1 min later it came on for about 10 seconds, then turned off. About 15 seconds later the inverter shut itself off so I finished the load of clothes with the gas generator & just ran the well pump on the inverter.

Question: is the turbo fan working properly? Shouldn't it keep running as long as the inverter is warm? I suspect if the fan would keep running the inverter could handle both washing machine and pump- any ideas? Good Luck & keep up the good work, Sincerely, Randy McLester, Whitehall, MT

The fan in the Trace is controlled by a thermal sensor hooked to the heatsink holding all the MOSFETs. Turning on and off is normal when the heatsink gets hot. My guess is that the combined wattage of both the pump and washer is greater than the Trace can sustain. Just run them one at a time. RP

MECHANICAL TECHNOLOGY

Dear Home Power, I am a recent subscriber and also have had access to back issues of your magazine. After reading them, skimming some articles, I have a much broader knowledge of alternative technology. I have one small PV panel which charges an old car battery that runs my radio/tape deck. Otherwise, I have no electricity, I use ice in an old fridge frozen in a neighbor's freezer. I don't have access to a lot of money to buy the equipment needed to electrify my house so I'm interested in tapping into any information anyone might have for mechanical appliances. I'm sure we can eliminate some of the need for electricity, thus cutting down on electrical energy fields in our living situation.

A friend who lived in Arkansas for a while, told me of a blender that was run by hand through a series of gears. A wheel was turned and the blender whizzed. Right now, that's my main interest. If there is anyone who could help me with this , I'd be most appreciative.

In one of your back issues, I read an article about the importance of teaching children about AE and I heartily agree.But something more important, I think, is to teach children the joys of nature and living without a lot of gadgets. For me, watching a storm come in or the trees swaying in the breeze is much more entertaining than any TV show or video or pacman game. I appreciate your magazine and what you are doing. I like the quality of the writing and the information. Do you know of any programs where poor people can get AE (refrigeration is my need. Oh, a SunFrost would be wonderful). Sincerely yours, Linda Tompkins, Tucson, AZ

About a mechanical blender, Linda, Bob-O says you should find an old style hand cranked cream separator. They have the gears to make the blades whiz real fast. No, I don't know of any programs to help low income families get AE. Although Harold, our old propane Servel works fine I too dream of a SunFrost. KJS

THE WINNER

Dear Home Power, I would like to thank you for publishing an informative magazine. As a recent subscriber I found it desirable to have all of the back issues in order to have as much information available on alternative energy as possible; information based on real experience. This same search for more knowledge prompted me to attend your Midwest Energy Fair at Amherst, Wisconsin. It was there that I purchased a raffle ticket for the illusive Home Power #1, and by good fortune, I was the lucky winner. GREAT!

At the Fair I was pleased to meet some of the fine people who are trying and making alternative energy resources work. The workshops were informative and the people at the display booths were helpful and knowledgeable. Thank you for putting it together.

P.S. I am presently trying to put together a workable system using NI-CADS; and in talking to the people at the Pacific West Supply Co. it was brought to my attention that Heliotrope General has an inverter that can be used with them. I confirmed it with Heliotrope General; it is their PSTT-12-2500 rated at a continuous 2500 Watts and an input of 16.5 or slightly more volts DC. You mentioned the desirability of such an inverter at one of your workshops. I thought I would pass the information along in case you were unaware of it.

Pete Ivashchenko, Round Lake Beach,IL

Congratulations, Pete! You now own a copy of the coveted HP #1. The Crew remembers you and that you really wanted #1. We can't take credit for the Midwest Renewable Energy Fair. It was the offspring of an energized band-o-loons with a vision. And they sure did it up right! A thoroughly enjoyable event. KJS

Ozonal Notes

Here's where we get to discuss the nuts and bolts operation of the World in general and Home Power in specific.

This last summer was a whirlwind of Energy Fair activity. We at HP wish we had had more time to attend the far-flung fairs around the nation. But we've heard reports about the goings on. Good Work.

With the nation shuddering under the uncertainty of another war (this one over energy), we all need to let everyone know what we've learned from our experiences with renewable energy. We at HP are trying to do just that. In the words of Paul Wilkins of PVNN,

" *Nobody has to die for solar energy."*

Karen & I have actually and officially gotten out of the renewable energy hardware business. We are now doing only Home Power Magazine. Electron Connection Ltd. is now the business of Bob-O Schultze and we wish him the best in his new venture. Fact is that Karen and I were far too busy with the magazine to really pay attention to our hardware business. Paying customers deserve better than partial attention. Rather than disband Electron Connection and put those working for it out of a job, we sold the company to someone we know will do a good job and do right by his customers. Also, the spectre of "conflict of interest" raised its ugly head. So, now neither Karen or I have any financial stakes in any renewable energy hardware, we don't sell anything except magazines. We are happy with this change and will do our level best to serve you via Home Power Magazine.

I'll still keep my hand in on systems, though. We are constantly expanding our system and I help our friends and neighbors. But I'm not doing it for pay anymore. After 14 years of specing and installing systems for others, I've climbed on my last roof for bucks. I've done over a hundred systems and I figure it's some one else's turn in the field.

All this means that we can concentrate on making Home Power a better publication which can better spread the word about renewable energy and what it can do for all of us.

This issue of Home Power is being printed by a new printer. We decided that it was worth the extra cost for a magazine that was not over-inked, cut crooked, and delivered late. We are learning. Neither Karen nor I have published a magazine before and the learning curve looks like a wall, even after three years of actually doing it. We get by with a little help from our friends (Thanks to all of you!).

We are actively researching electric vehicles and will soon be building prototypes. In Karen's words, "I want an EV more than I want indoor plumbing!" So we are starting design and construction of a four wheel drive backwoods solar electric buckboard. Steve Borgatti of Yreka CA will be doing the metal work, I will be doing the overall design & the electrics (leaning heavily on microprocessors) and the Wiz will be writing the computer code that makes it go down the road. Our design criteria is a totally PV powered vehicle, 30 mph tops, 50 mile range, and 800 to 1,000 pound payload. This will be a backwoods machine capable of doing it in the dirt & mud, with large wheels and lots of ground clearance. We consider this EV, named "Oozie" (named after Karen's horse), a class project and will provide everything we learn in these pages.

Energetically,

Richard for the Whole HP Crew.

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"The man who on his trade relies
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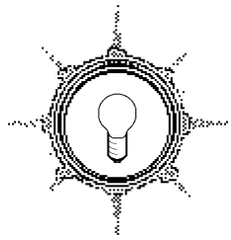
Thomas Lipton - 1870.



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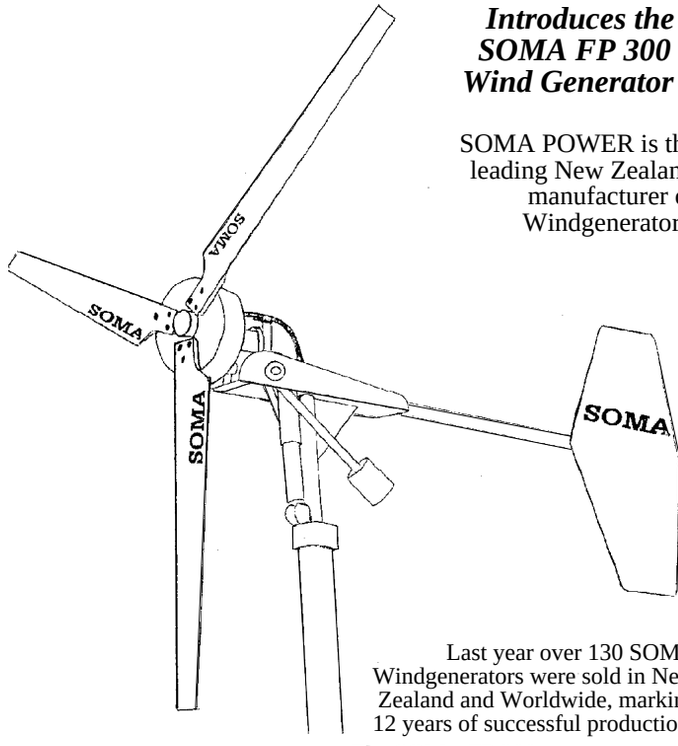

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